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Industrial automation systems and integration – Integration of life-cycle data for oil and gas production facilities – Part 2: Data model

ABSTRACT:

The data model specification of ISO 15926, standardising the computer data representation of life-cycle oil and gas facilities information.

KEYWORDS:

Industrial data, oil, gas, facility, life-cycle, integration, data model, specification, exchange

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Comments to reader:

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 15926-2 was prepared by Technical Committee ISO/TC184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 15926 consists of the following parts under the general title *Industrial automation systems and integration – Integration of lifecycle data for oil and gas production facilities*:

— Part 1, Overview and fundamental principles;

— Part 2, Data model;

— Part 3, Methodology for the development and maintenance of reference data libraries.

The structure of this International Standard is described in ISO 15926-1.

Annex A forms an integral part of this part of ISO 15926. Annex B is informative only.

Introduction

ISO 15926 is an International Standard for the representation of oil and gas production facility life-cycle information. This representation is specified by a generic, conceptual data model that is suitable as the basis for implementation in a shared database or data warehouse. The data model is designed to be used in conjunction with reference data - instances of the generic data model that are associated with particular application semantics.

ISO 15926 is organized as a number of parts, each published separately. This part of ISO 15926 specifies the data model.

Industrial automation systems and integration – Integration of life-cycle data for oil and gas production facilities – Part 2: Data model

1 Scope

This part of ISO 15926 specifies a conceptual data model that integrates the information requirements of oil and gas facility industry technical applications within a single conceptual framework to enable excahnge and sharing.

The data model covers the concepts of:

a) physical object;

b) functionals and roles;

c) activity and involvement;

d) information and encoded information;

e) person and organization;

f) characteristic, property, temporal aspect, spatial aspect, atomic arrangement;

g) state;

h) class, specialization, and classification;

i) class of individual , and class of class;

j) association, class of association, and association cardinality;

k) specific and typical individual;

l) single and collective individual;

m) whole , aspect, and possession of aspect;

n) actual, planned, predicted and required, and fulfilment;

o) real,

p) asserting and denying relationships;

q) composition, collection and assembly;

r) connection;

s) classification and specialisation;

t) installation and assignment;

u) description and identification;

v) derivation, version, alternative, succession, redundancy;

w) authorisation and control.

The data model does not describe or specify any particular application viewpoint of oil and gas facility information.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1994, *Information technology – Open systems interconnection – Abstract syntax notation one (ASN.1) – Part 1: Specification of basic notation.*

ISO 10303-11:1994, *Industrial automation systems and integration – Product data representation and exchange – Part 11: The EXPRESS language reference manual.*

ISO/CD 15926-1[1)], *Industrial automation systems and integration – Integration of life-cycle data for oil and gas production facilities – Part 1: Overview and fundamental principles*

3 Definitions

For the purposes of this part of ISO 15926 the terms given in ISO 15926-1 apply.

4 Use of ISO 10303-11 EXPRESS

The data model is specified using the EXPRESS language defined in ISO 10303-11. Not all the features of this language are used by ISO 15926.

The following EXPRESS constructs are excluded from the specification of the data model:

a) constructed data types;

b) generalised data types;

c) parameter data types;

d) array and bag aggregate types;

e) derived attributes;

[1] To be published.

f) inverse attributes

g) domain rules (where clause);

h) uniqueness rules;

i) global rules;

j) algorithms;

k) constants.

Entity type and attribute names have no additional restrictions to those of the EXPRESS language standard.

5 Database identifiers

Each instance within a conforming database or exchange file implementation may have an artificial unique internal identifier, this being the system-defined surrogate for the entity the instance represents.

The internal identifier is omitted from the data model specification because it is only known and valid within the scope of the system defining it.

6 Oil & Gas Facility Lifecycle Information

Integration of facility life cycle data is a primary requirement of the data model. Data integration means combining information derived from several independent sources into one coherent set of data that represents what is known. Because the independent sources often have overlapping scopes, combining their data requires the common things to be recognised, duplicate information to be removed, and any new information included.

To succeed in the role of integration, the data model must have a context that can include all the possible data that might be wanted or required. The ISO 15926 data model is a conceptual model in the sense described by ANSI/SPARC [2]. The model excludes all business rules that are appropriate only to specific applications to give a stable and flexible model with respect to developing and changing business practices.

NOTE The basis of this International Standard in the ANSI/SPARC architecture is described in clause 5.2 of ISO 15926-1.

7 Oil and gas production facilities

The documentation of the model schema subdivides the schema into smaller more understandable parts or sections. The parts are presentational in nature only and have no impact on the schema definition. They are not separate or separable schemas.

The following EXPRESS declaration begins the **oil_and_gas_production_facilities_schema**. There are no external references.

EXPRESS specification:

```
*)
SCHEMA oil_and_gas_production_facilities_schema;

(* Derived from POSC/CAESAR Draft Version 1 specification of 1999-02-18
```

7.1 Application object

A description of the uses of the entity types shown in this section will go here, eventually.

7.1.1 application_object

An **application_object** is something that can have its existence recorded. An **application_object** must be either an Individual or a Class.

EXAMPLE 1 The centrifugal pump with serial number AB/1234 is an Application_object.

EXAMPLE 2 The class "centrifugal pump" is an Application_object.

EXAMPLE 3 The company Bloggs & Co. is an Application_object.

EXAMPLE 4 Any relationship between the pump AB/1234 and Bloggs & Co. is an Application_object.

EXAMPLE 5 The degree of hotness corresponding to 20 degrees on the Centigrade scale is an Application_object.

EXAMPLE 6 The constructing of the Åsgard B production facility is an Application_object.

EXPRESS specification:

```
*)
ENTITY application_object
   ABSTRACT SUPERTYPE OF (ONEOF (class, individual));
   exchange_identifier : OPTIONAL STRING;
END_ENTITY;
(*
```

Attribute definitions:

exchange_identifier: the exchange_identifier is a string of characters that identifies the application object and that supports the consolidation of data about the application object contained in multiple data exchanges. The usage of the exchange_identifier shall be agreed among the parties involved in the multiple exchanges.

The exchange_identifier shall be determined in an exchange file but may not be determined in a database implementation.

7.1.2 classification

A classification is a possessed_association that indicates a class of which an Application_object is a member.

EXAMPLE 1 The relationship between the pump with serial number AB/1234 and the Class "Centrifugal pump" indicating that the pump is a centrifugal pump is a Classification.

EXAMPLE 2 The relationship between the Class "Centrifugal pump" and the Class "Type of mechanical equipment" that indicates that centrifugal pump is a type of mechanical equipment is a Classification.

EXPRESS specification:

```
*)
ENTITY classification
   ABSTRACT SUPERTYPE
   SUBTYPE OF (possessed_association);
   classified : application_object;
   classifier : class;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified is the application object that is a member of the class.

classifier: The classifier is the class that has the application_object as a member.

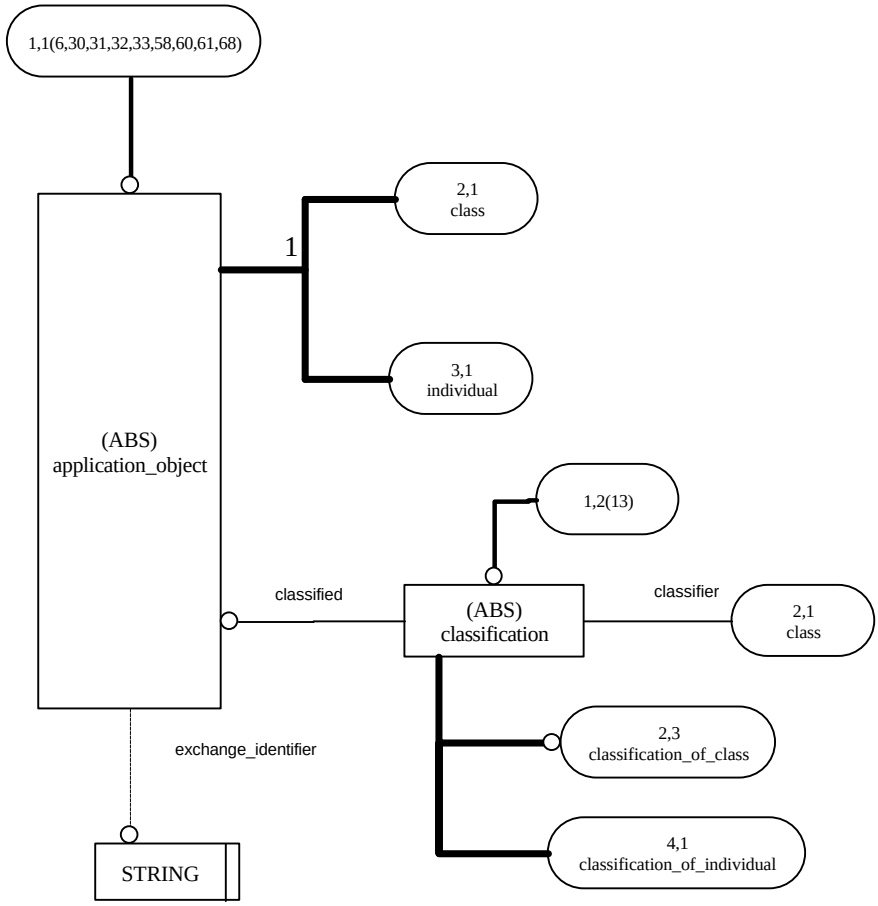


Figure 1 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Application object

7.2 Class

A description of the uses of the entity types shown in this section will go here, eventually.

7.2.1 class

A Class is an Application_object that is an understanding of the nature of things; and that divides things into those which are members of a class and those which are not according to one or more criteria.

A class exists even if it has no known members.

A Class is must be either a Class_of_individual or a Class_of_class.

EXAMPLE 1 Centrifugal pump is a Class.

EXAMPLE 2 Mechanical equipment type is a Class.

EXAMPLE 3 Temperature is a Class.

EXAMPLE 4 Commercial fusion reactor is a Class.

EXAMPLE 5 Centigrade scale is a class.

EXPRESS specification:

```
*)
ENTITY class
   ABSTRACT SUPERTYPE OF (ONEOF (class_of_class, class_of_individual))
   SUBTYPE OF (application_object);
END_ENTITY;
(*
```

7.2.2 class_of_class

A Class_of_class is a class that can have another class as a member and that cannot have an individual as a member.

EXAMPLE 1 Mechanical equipment type is a Class_of_class.

EXAMPLE 2 ASME Type is a Class_of_class the members being classes that are recognized by ASME standards.

EXPRESS specification:

```
*)
ENTITY class_of_class
   SUBTYPE OF (class);
END_ENTITY;
(*
```

7.2.3 classification_of_class

A classification_of_class is a classification that classifies a class.

EXAMPLE The relationship between the Class "Centrifugal pump" and the Class "Type of mechanical equipment" that indicates that centrifugal pump is a type of mechanical equipment is a Classification_of_class.

EXPRESS specification:

```
*)
ENTITY classification_of_class
   SUBTYPE OF (classification);
   SELF\classification.classified : class;
   SELF\classification.classifier : class_of_class;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified is the Class that is a member of the Class_of_class.

classifier: The classifier is the Class_of_class that the classified Class as a member.

7.2.4 custody_of_class_definition

A Custody_of_class_definition is a Possessed_association that indicates the custodian organization produces and or revises the information that defines the class.

EXAMPLE The relationship between the Organization ASME and the Class ASME B16.9 that indicates that ASME is the source and owner of the definition of the B16.9 class is a Custody_of_class_definition.

EXPRESS specification:

```
*)
ENTITY custody_of_class_definition
   SUBTYPE OF (possessed_association);
   custodian : organization;
   held      : class;
END_ENTITY;
(*
```

Attribute definitions:

custodian: The custodian is the Organization that produces or revises the information defining the Class.

held: The held is the Class whose definition is produced and or revised by the custodian Organization.

7.2.5 specialization_of_class

A Specialization_of_class is a Common_association linking a subclass and a superclass that indicates the sub-class has more constrained criteria for membership than the superclass; and each member of the subclass is also a member of the superclass.

EXAMPLE The relationship between the Class "pump" and the Class "centrifugal pump" that indicates that all centrifugal pumps are pumps is a Specialization_of_class.

EXPRESS specification:

```
*)
ENTITY specialization_of_class
   SUBTYPE OF (common_association);
   subclass   : class;
   superclass : class;
END_ENTITY;
(*
```

Attribute definitions:

subclass: The subclass is the class that is narrower and has more constrained criteria for membership than the superclass.

The subclass role corresponds the role_1 of the Common_association cardinality data.

superclass: The superclass is the Class that is broader and has less constrained criteria for membership than the subclass.

The superclass role corresponds to role_2 of the Common_association cardinality data.

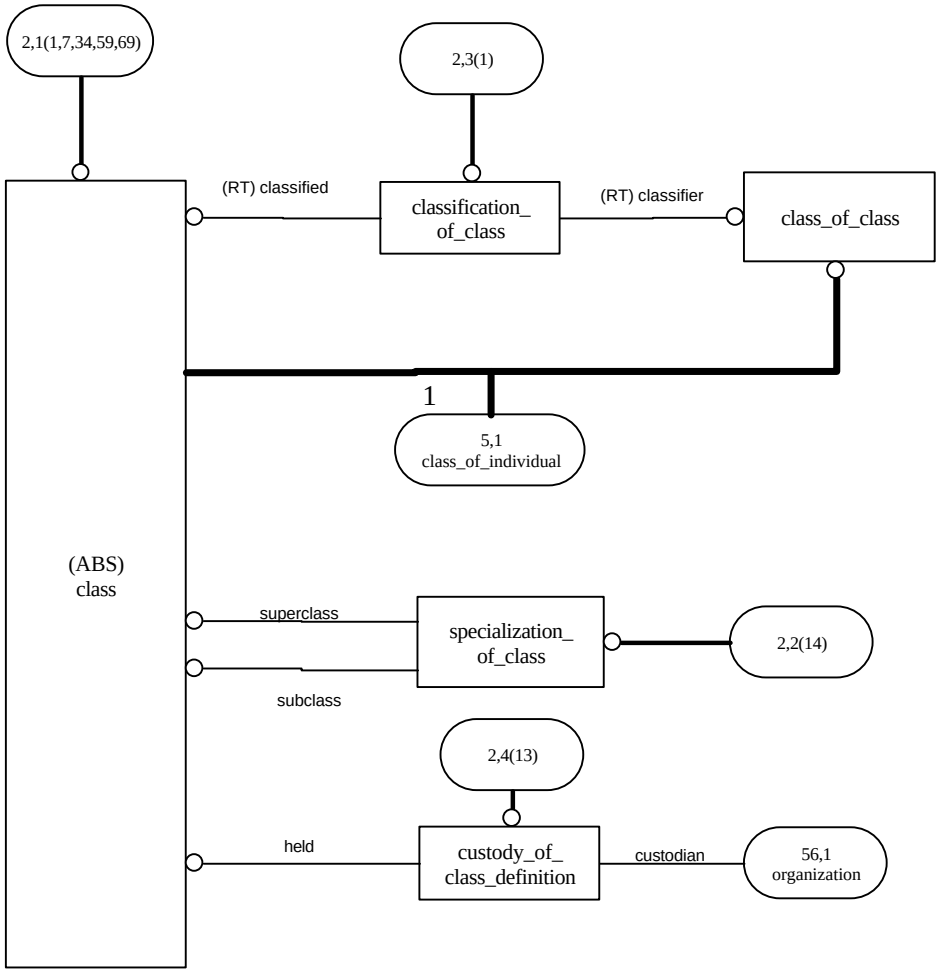


Figure 2 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class

7.3 Individual

A description of the uses of the entity types shown in this section will go here, eventually.

7.3.1 assembly_of_individual

An Assembly_of_individual is a Composition_of_individual that has a Single_individual as the whole and indicates the part plays a particular role within the whole.

EXAMPLE 1 The relationship between the centrifugal pump with serial number AB/1234 and the impeller with serial number I/47Z23 that indicates that the impeller is fitted within the pump is an Assembly_of_individual.

EXAMPLE 2 The relationship between the sales department of the XYZ Co. and the XYZ Co. that indicates that the sales department is a function of the XYZ Co. is an Assembly_of_individual.

EXPRESS specification:

```
*)
ENTITY assembly_of_individual
   SUBTYPE OF (composition_of_individual);
   SELF\composition_of_individual.whole : single_individual;
END_ENTITY;
(*
```

Attribute definitions:

whole: The Single_individual that is the whole for the part.

7.3.2 classification_of_individual

A Classification_of_individual is a Classification that classifies an Individual.

EXAMPLE The relationship between the pump with serial number AB/1234 and the Class "Centrifugal pump" indicating that the pump is a centrifugal pump is a Classification_of_individual.

EXPRESS specification:

```
*)
ENTITY classification_of_individual
   SUPERTYPE OF (ONEOF (essential_classification_of_individual,
                        incidental_classification_of_individual)
           ANDOR classification_of_physical_object_by_role)
   SUBTYPE OF (classification);
   SELF\classification.classified : individual;
   SELF\classification.classifier : class_of_individual;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified is the Individual that is a member of the classifier Class_of_individual.

classifier: The classifier specifies the Class_of_individual that has the classified individual as a member.

7.3.3 collection_of_individual

A Collection_of_individual is a Composition_of_individual that has a Plural_individual as the whole, where the part does not play a particular role within the whole.

EXAMPLE The relationship that indicates my computer terminal is amongst the set of things on my desk top is a Collection_of_individual.

EXPRESS specification:

```
*)
ENTITY collection_of_individual
   SUBTYPE OF (composition_of_individual);
   SELF\composition_of_individual.whole : plural_individual;
END_ENTITY;
(*
```

Attribute definitions:

whole: The whole specifies the plural individual that includes the part.

7.3.4 composition_of_individual

A Composition_of_individual is a possessed_association that indicates the part individual is a part of the whole individual.

EXAMPLE The relationship between the Individual that is the Rio Grande LPG plant and the Individual that is the turbo expansion unit that indicates the unit is part of the plant is a Composition_of_individual.

EXPRESS specification:

```
*)
ENTITY composition_of_individual
   SUPERTYPE OF (ONEOF (composition_of_possessed_aspect,
                        composition_of_activity,
                        composition_of_physical_object)
           ANDOR ONEOF (collection_of_individual,
                        assembly_of_individual))
   SUBTYPE OF (possessed_association);
   whole : individual;
   part  : individual;
END_ENTITY;
(*
```

Attribute definitions:

whole: The whole specifies the individual that is the whole for the part.

part: The part specifies the Individual that is the part for the whole.

7.3.5 essential_classification_of_individual

An Essential_classification_of_individual is a Classification_of_individual that remains unchanged throughout the life of an individual.

EXAMPLE If feedstock is deemed to no longer exist once processed into products, then the relationship that indicates that material is feedstock is an Essential_classification_of_individual.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_individual
   SUPERTYPE OF (ONEOF (essential_classification_of_possessed_aspect,
                        essential_classification_of_possessed_association,
                        essential_classification_of_possessed_state,
                        essential_classification_of_activity,
                        essential_classification_of_physical_object,
                        essential_classification_of_information,
                        essential_classification_of_encoded_information,
                        classification_of_involvement_by_role,
                        classification_of_role_in_life_of_physical_object))
   SUBTYPE OF (classification_of_individual);
END_ENTITY;
(*
```

7.3.6 incidental_classification_of_individual

An Incidental_classification_of_individual is a Classification_of_individual that can begin and end during the life of the individual.

EXAMPLE The relationship between a hot casting and the Class "hot" indicating that the casting is a assessed as hot is an Incidental_classification_of_individual.

EXPRESS specification:

```
*)
ENTITY incidental_classification_of_individual
   SUBTYPE OF (classification_of_individual);
END_ENTITY;
(*
```

7.3.7 individual

An individual is an Application_object that has a unique existence in the world with a beginning and an end.

EXAMPLE 1 The Rio Grande LPG plant in Santa Cruz, Bolivia is an Individual.

EXAMPLE 2 The vessel with serial number V-1234 is an Individual.

EXAMPLE 3 The company Bloggs & Co. is an Individual.

EXAMPLE 4 The building of the Åsgard B offshore oil facility is an Individual

EXAMPLE 5 The temperature of the sun is an Individual.

EXAMPLE 6 The shape of Oslo Fjord is an individual.

EXPRESS specification:

```
*)
ENTITY individual
   ABSTRACT SUPERTYPE OF (ONEOF (activity,
                                 physical_object,
                                 information,
                                 encoded_information)
                     ANDOR ONEOF (whole_individual,
                                  possessed_aspect)
                     ANDOR ONEOF (specific_individual,
                                  typical_individual)
                     ANDOR ONEOF (plural_individual,
                                  single_individual))
   SUBTYPE OF (application_object);
END_ENTITY;
(*
```

7.3.8 plural_individual

A Plural_individual is an Individual that has parts which play no role with respect to the whole.

EXAMPLE 1 The set of things on the top of my desk is a Plural_individual.

EXAMPLE 2 The set of cars in the office car park now is a Plural_individual.

EXAMPLE 3 The disassembled parts of my personal computer is not a Plural_individual. They have roles with respect to each other and can be assembled.

EXPRESS specification:

```
*)
ENTITY plural_individual
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.3.9 single_individual

A Single_individual is an Individual that has parts which each play a different role with respect to the whole.

The qualities of a Single_individual are the qualities of its parts.

EXAMPLE 1 The vessel with serial number V-1234 is a Single_individual.

EXAMPLE 2 The company Bloggs & Co. is a Single_individual.

EXAMPLE 3 My PC that consists of the main unit with its removable CD-ROM and Floppy disk drives and power supply cables is a Single_individual.

EXPRESS specification:

```
*)
ENTITY single_individual
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.3.10 specific_individual

A Specific_individual is an Individual that has an actual existence in the world, or a required planned or predicted existence in a future world.

EXAMPLE 1 The Vessel with serial number V-1234 that has or will be built is a Specific_individual.

EXAMPLE 2 The assumptions made about a vessel for design purposes is a Typical_individual.

EXPRESS specification:

```
*)
ENTITY specific_individual
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.3.11 typical_individual

A Typical_individual is an Individual that is a hypothetical member of a Class and that is similar to all other members of the class.

EXAMPLE .The assumptions made about the stress behaviour of a type of vessel is a Typical_individual.

EXPRESS specification:

```
*)
ENTITY typical_individual
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.3.12 whole_individual

A Whole_individual is an Individual that has independent existence and that is not an aspect possessed by an individual. An aspect possessed by an individual is unable to exist independently of its possessor.

A Whole_individual is an individual that combines all aspects of a single concept. A whole may have required, planned, predicted and actual aspects.

EXAMPLE The Åsgard B production facility is Whole_individual. It has separate identity, it can be a part of a larger thing, and includes required, planned, predicted and actual aspects.

EXPRESS specification:

```
*)
ENTITY whole_individual
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

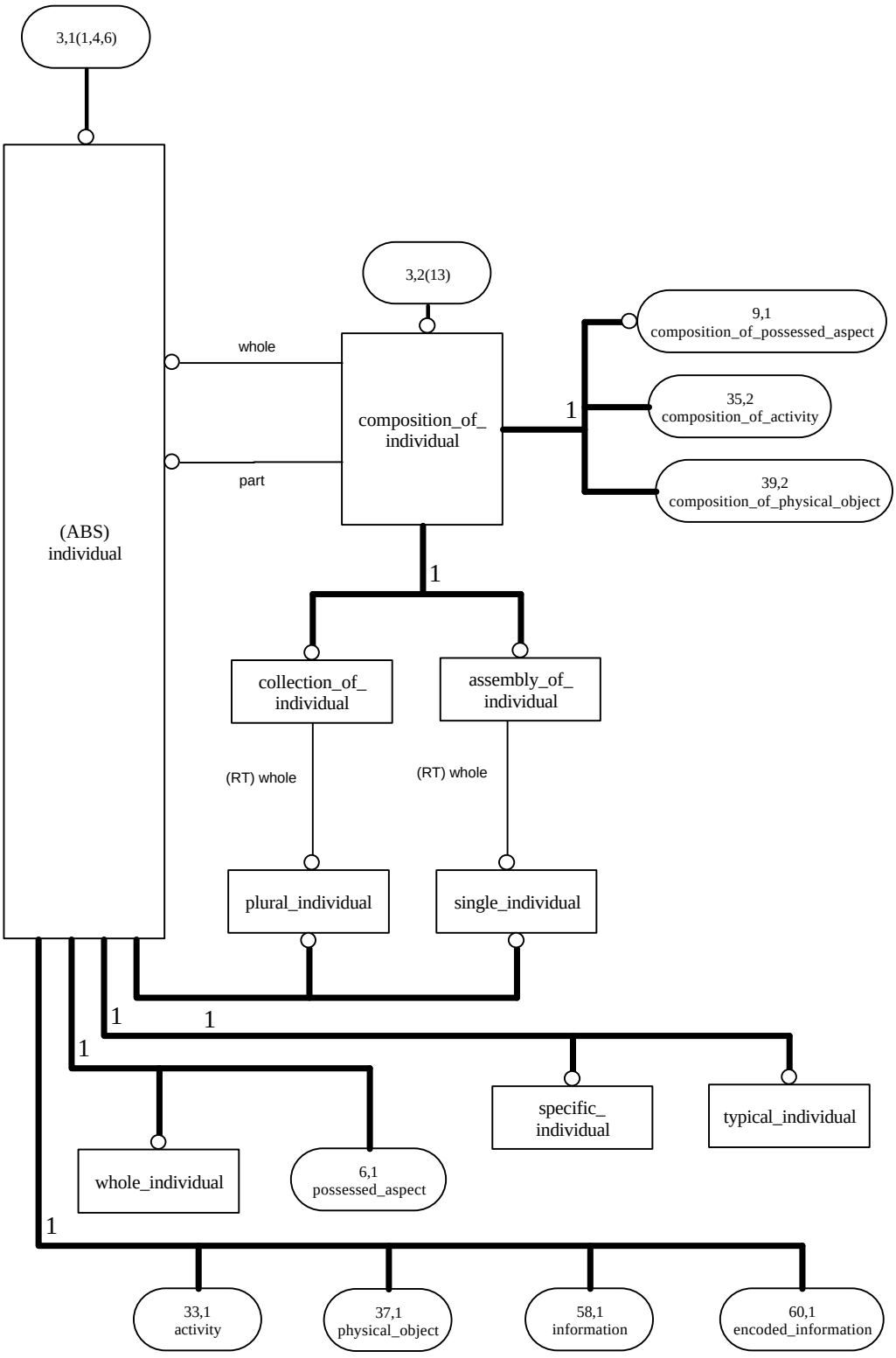


Figure 3 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Individual (1 of 2)

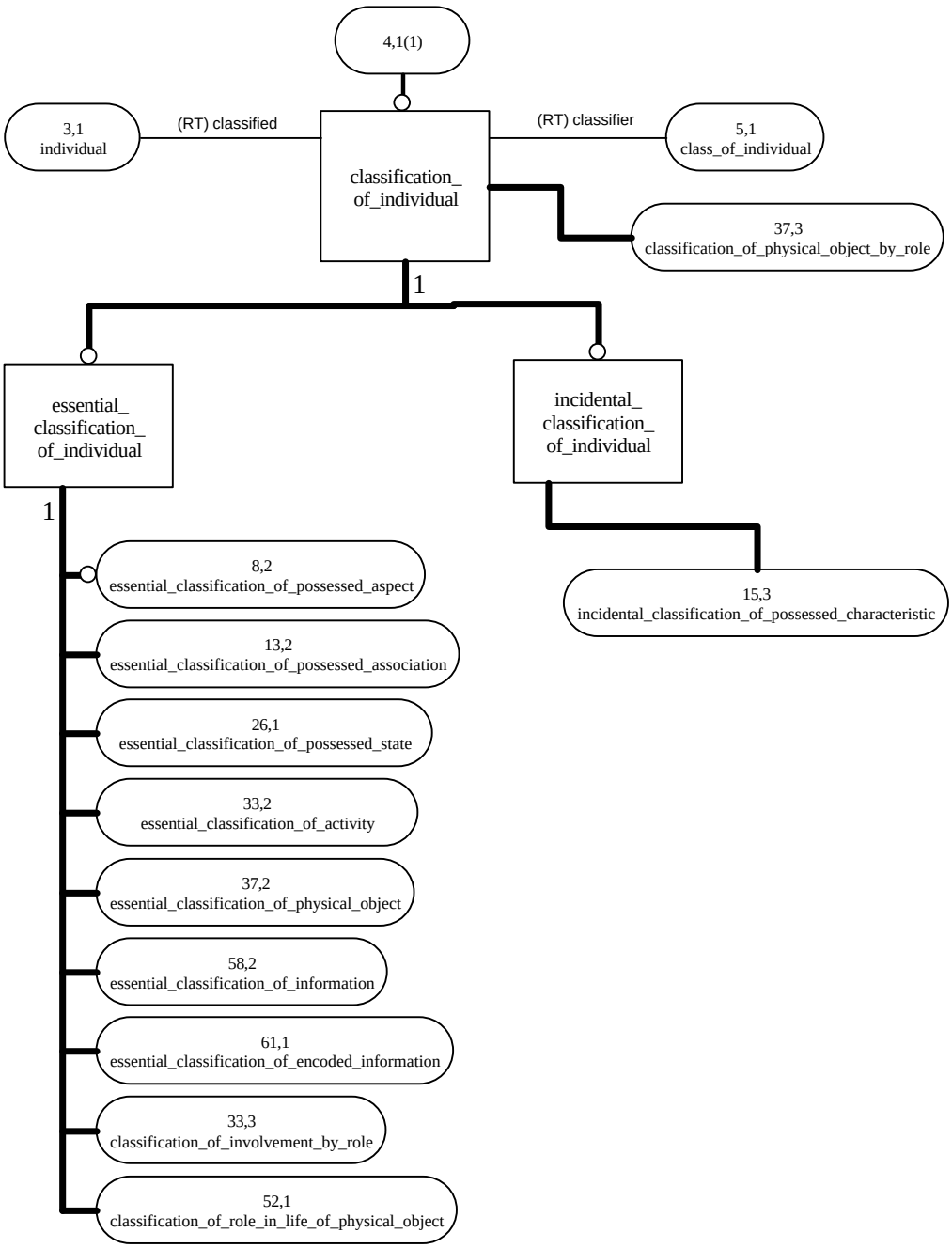


Figure 4 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema Individual – (2 of 2)

7.4 Class of individual

A description of the uses of the entity types shown in this section will go here, eventually.

7.4.1 class_of_individual

A Class_of_individual is a Class that can have an Individual as a member and cannot have a class as a member.

EXAMPLE Centrifugal pump, meaning the centrifugal common nature pumps, is a Class_of_individual.

EXPRESS specification:

```
*)
ENTITY class_of_individual
   ABSTRACT SUPERTYPE OF (ONEOF (class_of_plural_individual,
                                 class_of_single_individual)
                    ANDOR ONEOF (class_of_whole_individual,
                                 class_of_aspect)
                    ANDOR ONEOF (class_of_activity,
                                 class_of_physical_object,
                                 class_of_information,
                                 class_of_encoded_information))
   SUBTYPE OF (class);
END_ENTITY;
(*
```

7.4.2 class_of_plural_individual

A Class_of_plural_individual is a Class_of_individual is a specialisation of Plural_individual that indicates a common nature of plural individuals.

EXAMPLE Stock of 100mm x 10mm nuts and bolts is a Class_of_plural_individual.

EXPRESS specification:

```
*)
ENTITY class_of_plural_individual
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.4.3 class_of_single_individual

A Class_of_single_individual is a Class_of_individual that is a specialization of Single_individual that indicates the a common nature of singular individuals.

EXAMPLE Nut and bolt is a Class_of_single_individual and a Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY class_of_single_individual
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.4.4 class_of_whole_individual

A Class_of_whole_individual is a Class_of_individual that is a specialization of Whole_individual that is a common nature of whole individuals.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY class_of_whole_individual
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.4.5 common_assembly_of_individual

A Common_assembly_of_individual is a Common_composition_of_individual that is a specialisation of Assembly_of_individual that constrains the members of the whole class to have members of the part class as parts.

EXAMPLE The class of relationship between the Class "centrifugal pump" and the Class "impeller" that indicates that centrifugal pumps have impellers as parts is a Common_assembly_of_individual.

EXPRESS specification:

```
*)
ENTITY common_assembly_of_individual
   SUBTYPE OF (common_composition_of_individual);
   SELF\common_composition_of_individual.whole : class_of_single_individual;
END_ENTITY;
(*
```

Attribute definitions:

whole: The whole specifies the Class_of_single_individual whose members can be a whole for members of the part class.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.4.6 common_collection_of_individual

A Common_collection_of_individual is a Common_composition_of_individual that is a specialisation of Collection_of_individual that constrains the members of the whole class to have members of the part class as parts.

EXAMPLE The class of relationship between the Class "stock of bolts" and the Class "bolt" that indicates a stock of bolts is a collection of bolts is a Common_collection_of_individual.

EXPRESS specification:

```
*)
ENTITY common_collection_of_individual
   SUBTYPE OF (common_composition_of_individual);
   SELF\common_composition_of_individual.whole : class_of_plural_individual;
END_ENTITY;
(*
```

Attribute definitions:

whole: The whole specifies the Class_of_plural_individual whose members can be a whole for members of the part class.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.4.7 common_composition_of_individual

A Common_composition_of_individual is a Common_association that is a specialisation of Composition_of_individual that constrains the members of the whole class to have members of the part class as parts.

EXAMPLE The class of relationship between the Class_of_activity "Oil platform development" and the Class_of_activity "plant commissioning" that indicates platform development includes commissioning is a Common_composition_of_individual, a Common_assembly_of_individual and a Common_composition_of_activity.

EXPRESS specification:

```
*)
ENTITY common_composition_of_individual
   SUPERTYPE OF (ONEOF (common_assembly_of_individual,
                        common_collection_of_individual)
           ANDOR ONEOF (common_composition_of_aspect,
                        common_composition_of_activity,
                        common_composition_of_physical_object))
   SUBTYPE OF (common_association);
   part  : class_of_individual;
   whole : class_of_individual;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Class_of_individual whose members can be part of members of the whole class.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Class_of_individual whose members can be part of members of the part class.

The whole role corresponds to role_2 of the Common_association cardinality data.

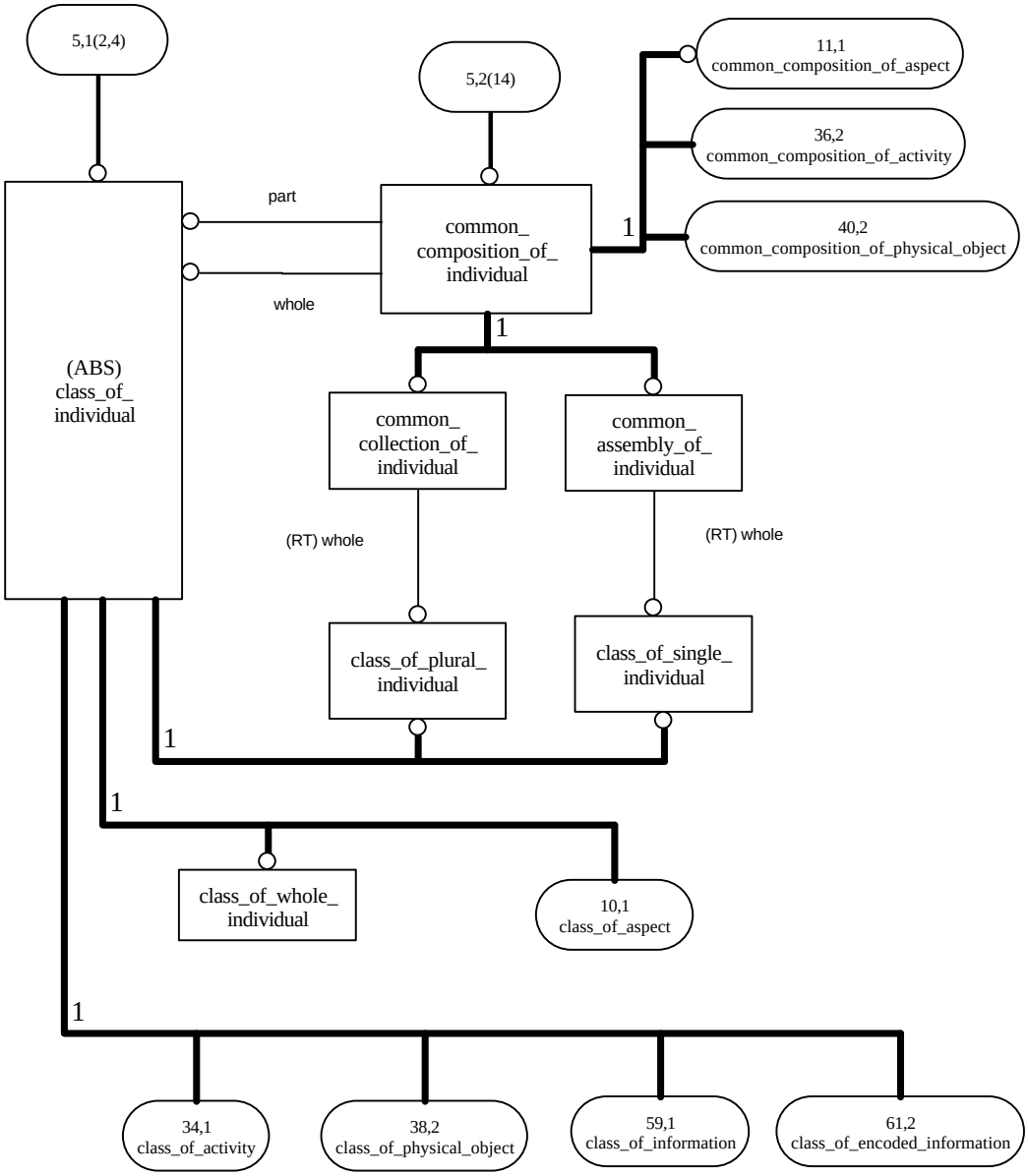


Figure 5 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of individual

7.5 Aspect of individual

A description of the uses of the entity types shown in this section will go here, eventually.

7.5.1 aspect_possessed_by_individual

An Aspect_possessed_by_individual is a Possessed_aspect that is an intrinsic part of another Individual.

EXAMPLE 1 The pattern of waves on the surface of the water is an Aspect_possessed_by_individual.

EXAMPLE 2 The planned operating temperature of the reactor unit is an Aspect_possessed_by_individual and an Possessed_planned_aspect that is possessed by the Possessed_actual_aspect of the Whole_individual that is the reactor unit.

EXPRESS specification:

```
*)
ENTITY aspect_possessed_by_individual
   SUPERTYPE OF (ONEOF (possessed_characteristic,
                        possessed_state,
                        possessed_event_effect,
                        possessed_decomposition_of_activity,
                        possessed_decomposition_aspect_of_physical_object,
                        possessed_topologic_sequence_aspect_of_physical_object,
                        possessed_routing_aspect_of_physical_object,
                        possessed_concatenation_aspect_of_encoded_textual_object,
                        possessed_concatenation_aspect_of_binary_object))
   SUBTYPE OF (possessed_aspect);
   SELF\possessed_aspect.possessor : individual;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the individual that possesses the aspect.

The Aspect_possessed_by_individual must be possessed by one and only one individual.

7.5.2 possessed_actual_aspect

A Possessed_actual_aspect is a Possessed_aspect that is how something actually is.

EXAMPLE The actual wall thickness of the vessel is a possessed_actual_aspect.

EXPRESS specification:

```
*)
ENTITY possessed_actual_aspect
   SUBTYPE OF (possessed_aspect);
END_ENTITY;
(*
```

7.5.3 possessed_aspect

A Possessed_aspect is an Individual that is a quality or state possessed by another Application_object. A possessed_aspect cannot exist without the Application_object that possesses it. A Possessed_aspect is an intrinsic, non-separable part of its possessor.

Possessed aspects must be predicted, required, planned or actual.

Possessed associations are regarded as a type of possessed aspect.

EXAMPLE 1 The shape of the computer is a Possessed_aspect of the computer. Note that the shape of another computer is a separate and distinct Possessed_aspect, possessed by the other computer. The similarity or common nature of these two shapes is expressed using classes of aspect.

EXAMPLE 2 The arrival time of the flight BA786 (2 Jan 1998) is a Possessed_aspect of the arrival.

EXPRESS specification:

```
*)
ENTITY possessed_aspect
   SUPERTYPE OF (ONEOF (possessed_predicted_aspect,
                        possessed_required_aspect,
                        possessed_planned_aspect,
                        possessed_actual_aspect)
           ANDOR ONEOF (aspect_possessed_by_individual,
                        possessed_association))
   SUBTYPE OF (individual);
   possessor : application_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Application_object that Possessed_aspect is an intrinsic part of.

Note that a Possessed_aspect must be possessed by one and only one Application_object.

7.5.4 possessed_planned_aspect

A Possessed_planned_aspect is a Possessed_aspect that is how something is intended to be.

EXAMPLE 1 The intended wall thickness is a possessed_planned_aspect of the vessel.

EXAMPLE 2 One plan for the Vessel XYZ_1234 is that it should have an external diameter of 2.5m. This plan for the vessel is a Possessed_planned_aspect of the Whole that is the vessel XYZ_1234.

EXAMPLE 3 .The actual Vessel XYZ_1234 turned out to have a diameter of 2.49m. The actual Vessel is a Possessed_actual_aspect of the same whole.

EXPRESS specification:

```
*)
ENTITY possessed_planned_aspect
   SUBTYPE OF (possessed_aspect);
END_ENTITY;
(*
```

7.5.5 possessed_predicted_aspect

A Possessed_predicted_aspect is a Possessed_aspect that is how something is predicted to be.

EXAMPLE The predicted wall thickness of the vessel is a Possessed_predicted_aspect possessed by the Whole vessel.

EXPRESS specification:

```
*)
ENTITY possessed_predicted_aspect
   SUBTYPE OF (possessed_aspect);
END_ENTITY;
(*
```

7.5.6 possessed_required_aspect

A Possessed_required_aspect is a Possessed_aspect that is how something is desired to be.

EXAMPLE The desired wall thickness of the vessel is a possessed_required_aspect possessed by the Whole vessel.

EXPRESS specification:

```
*)
ENTITY possessed_required_aspect
   SUBTYPE OF (possessed_aspect);
END_ENTITY;
(*
```

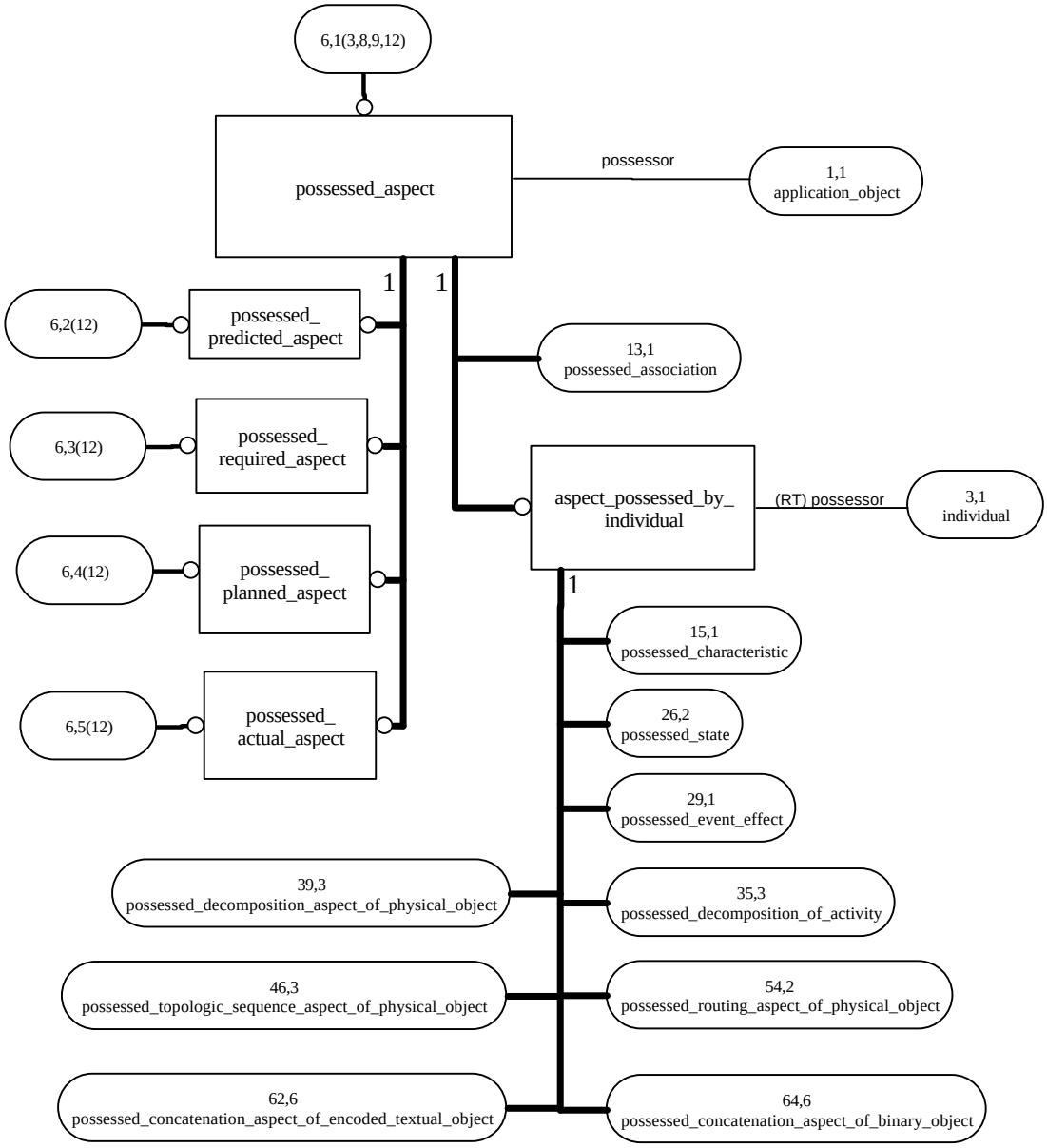


Figure 6 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Aspect of individual

7.6 Common aspect of individual

A description of the uses of the entity types shown in this section will go here, eventually.

7.6.1 common_possession_of_characteristic

A Common_possession_of_characteristic is a Common_association that indicates each member of the possessor class possess members of the possessed class.

A Common_possession_of_characteristic is a specialization of the relationship class named possessor that is an attribute of Possessed_aspect.

EXAMPLE The class of relationship between the Class "pipe" and the Class_of_characteristic "operating pressure" that indicates that a pipe possesses operating pressures is a Common_possession_of_characteristic.

EXPRESS specification:

```
*)
ENTITY common_possession_of_characteristic
   SUBTYPE OF (common_association);
   possessed : class_of_characteristic;
   possessor : class;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Class_of_characteristic that are possessed by members of the possessor class.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class whose members possess members of the possessed Class_of_characteristic.

The possessor role corresponds to role_2 of the Common_association cardinality data.

7.6.2 common_possession_of_identification_aspect

A Common_possession_of_identification_aspect is a Common_association that is a specialization of the possessor relationship that constrains members of the possessor class to have identification aspects that are members of the possessed class.

EXAMPLE: ??

EXPRESS specification:

```
*)
ENTITY common_possession_of_identification_aspect
   SUBTYPE OF (common_association);
   possessed : class_of_aspect;
   possessor : class;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Class_of_aspect that are possessed by members of the possessor class.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class whose members possess members of the possessed Class_of_aspect.

The possessor role corresponds to role_2 of the Common_association cardinality data.

7.6.3 common_possession_of_state

A Common_possession_of_state is a Common_association that indicates each member of the possessor class possesses members of the possessed Class_of_state.

EXAMPLE The class of relationship between the Class "drill bit" and the Class_of_state "condition" that indicates that drill bits possess a condition state is a Common_possession_of_state.

EXPRESS specification:

```
*)
ENTITY common_possession_of_state
   SUBTYPE OF (common_association);
   possessed : class_of_state;
   possessor : class;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Class_of_state whose members are possessed by members of the possessor class.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class whose members possess members of the possessed Class_of_state.

The possessor role corresponds to role_2 of the Common_association cardinality data.

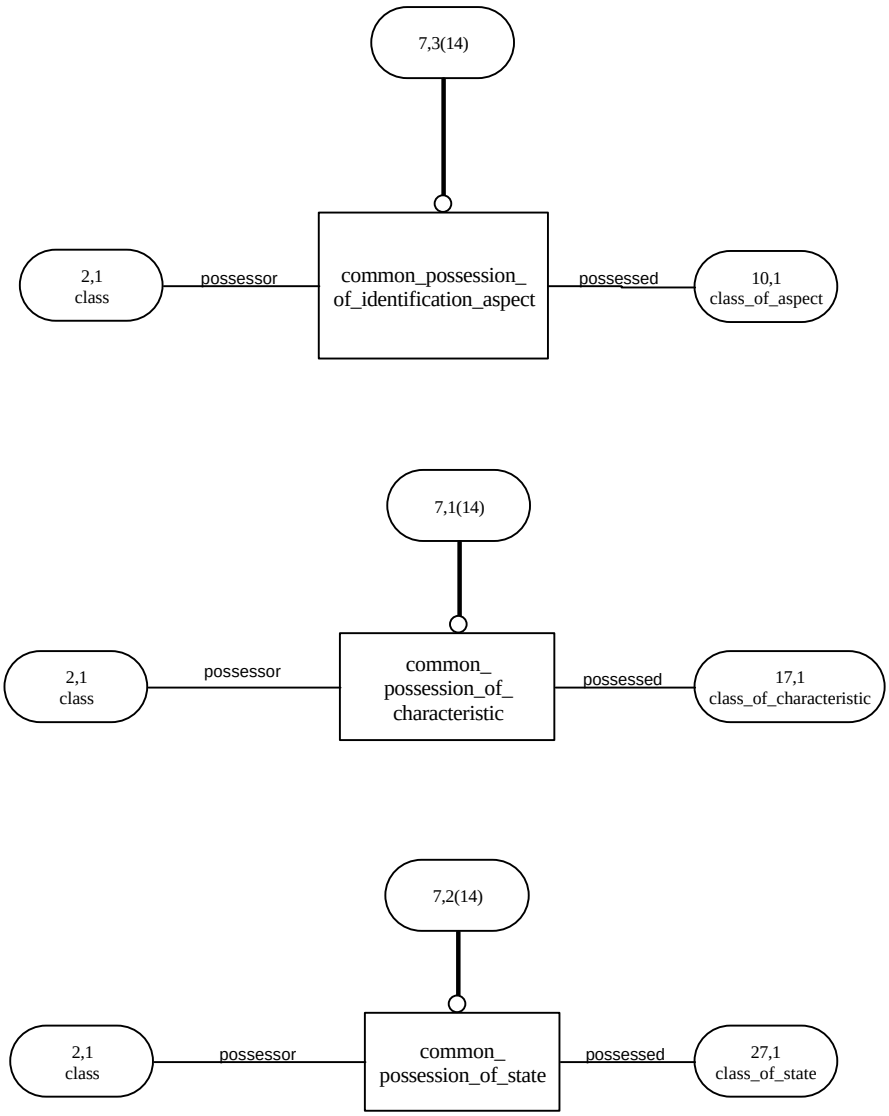


Figure 7 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common aspect of individual

7.7 Possessed aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.7.1 common_purpose_of_possessed_aspect

A Common_purpose_of_possessed_aspect is a Common_association that is a specialization of Purpose_of_possessed_aspect that constrains the aspect to have a member of the Class_of_activity as a purpose.

EXAMPLE The class of relationship between the shape aspect of the bucket and the Class_of_activity "holding liquids" is a Common_purpose_of_possessed_aspect.

EXPRESS specification:

```
*)
ENTITY common_purpose_of_possessed_aspect
   SUPERTYPE OF (ONEOF (common_purpose_of_approval,
                        common_purpose_of_possessed_protection))
   SUBTYPE OF (common_association);
   aspect  : possessed_aspect;
   purpose : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Possessed_aspect whose purpose is a member of the Class_of_activity.

The aspect role corresponds to role_1 of the Common_association cardinality data.

purpose: The purpose specifies the Class_of_activity whose members are reason for existence of the possessed aspect.

The purpose role corresponds to role_2 of the Common_association cardinality data.

7.7.2 composition_of_possessed_aspect

A Composition_of_possessed_aspect is a Composition_of_individual that is between two possessed_aspects that indicates the part Possessed_aspect is a part of the whole Possessed_aspect.

If the part Possessed_aspect, itself has parts, then each of its parts are parts of the whole, except those indicated as excluded by an Exception_of_possessed_aspect_from_composition.

A Composition_of_possessed_aspect is distinguished from Possession_of_aspect by the part aspect being a part of many aspects.

EXAMPLE The relationship between the Possessed_planned_aspect "ROS plant plan 1 power unit" that is part of the Possessed_planned_aspect "Plan 1 ROS plant" and the Possessed_planned_aspect of the Whole "diesel engine #wn56z28" that indicates that the Plan 1 plant power unit has the diesel engine as a part is a Composition_of_possessed_aspect.

EXPRESS specification:

```
*)
ENTITY composition_of_possessed_aspect
   SUPERTYPE OF (ONEOF (composition_of_decomposition_aspect_of_activity,
                        composition_of_decomposition_aspect_of_physical_object,
                       composition_of_topologic_sequence_aspect_of_physical_object,
                        composition_of_routing_aspect_of_physical_object,
                     composition_of_concatenation_aspect_of_encoded_textual_object,
                        composition_of_concatenation_aspect_of_binary_object))
   SUBTYPE OF (composition_of_individual);
   SELF\composition_of_individual.part : possessed_aspect;
   SELF\composition_of_individual.whole : possessed_aspect;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specified the Possessed_aspect that is the part of the whole.

Each part of the part is also a component of the whole, unless it is excluded.

whole: The whole specifies the Possessed_aspect that is the whole for the part.

7.7.3 essential_classification_of_possessed_aspect

An Essential_classification_of_possessed_aspect is an Essential_classification_of_individual that classifies a possessed_aspect.

EXAMPLE The relationship, between the connection of a flow sensor to a signal line that is a possessed aspect and the the Class_of_aspect "electrical connection", that indicates the connection can transfer electrical energy is an Essential_classification_of_possessed_aspect.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_possessed_aspect
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : possessed_aspect;
   SELF\classification_of_individual.classifier : class_of_aspect;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified is the Possessed_aspect that is a member of the classifier Class_of_aspect.

classifier: The classifier is the Class_of_aspect that has the classified Possessed_aspect as the member

7.7.4 exception_of_possessed_aspect_from_composition

An Exception_of_possessed_aspect_from_composition is a Possessed_association that indicates the excepted Possessed_aspect that is a part of the composition part is not a part of the Possessed_aspect indicated by the composition whole.

EXAMPLE In a second plan for the ROS plant, all the components remain the same except that the diesel engine of the power unit is replaced by another type with more power. The relationship between the diesel engine and the composition association that states the power unit is part of Plan 2 for the plant indicating the diesel engine is excluded from the power unit in plan 2 is an Exception_of_possessed_aspect_from_composition.

EXPRESS specification:

```
*)
ENTITY exception_of_possessed_aspect_from_composition
   SUBTYPE OF (possessed_association);
   composition : composition_of_possessed_aspect;
   excepted    : possessed_aspect;
END_ENTITY;
(*
```

Attribute definitions:

composition: The composition specifies the Composition_of_possessed_aspect that has the excluded Possessed_aspect excluded from the whole.

excepted: The excepted specifies the Possessed_aspect that is excluded from the composition whole Possessed_aspect.

7.7.5 purpose_of_possessed_aspect

A Purpose_of_possessed_aspect is Possessed_association that indicates the Possessed_aspect has an involvement in an activity as a reason for its existence.

EXAMPLE The relationship between the material aspect of a specially manufactured drill bit and the activity "drill hole 16/2A" that indicates the material is selected to give best performance for drilling the particular hole is a Purpose_of_possessed_aspect.

EXPRESS specification:

```
*)
ENTITY purpose_of_possessed_aspect
   SUPERTYPE OF (ONEOF (purpose_of_approval,
                        protection_from_hazard))
   SUBTYPE OF (possessed_association);
   aspect  : possessed_aspect;
   purpose : activity;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Possessed_aspect that has the Activity as a reason for existence.

purpose: The purpose specifies the activity that is a reason for existence for the Possessed_aspect.

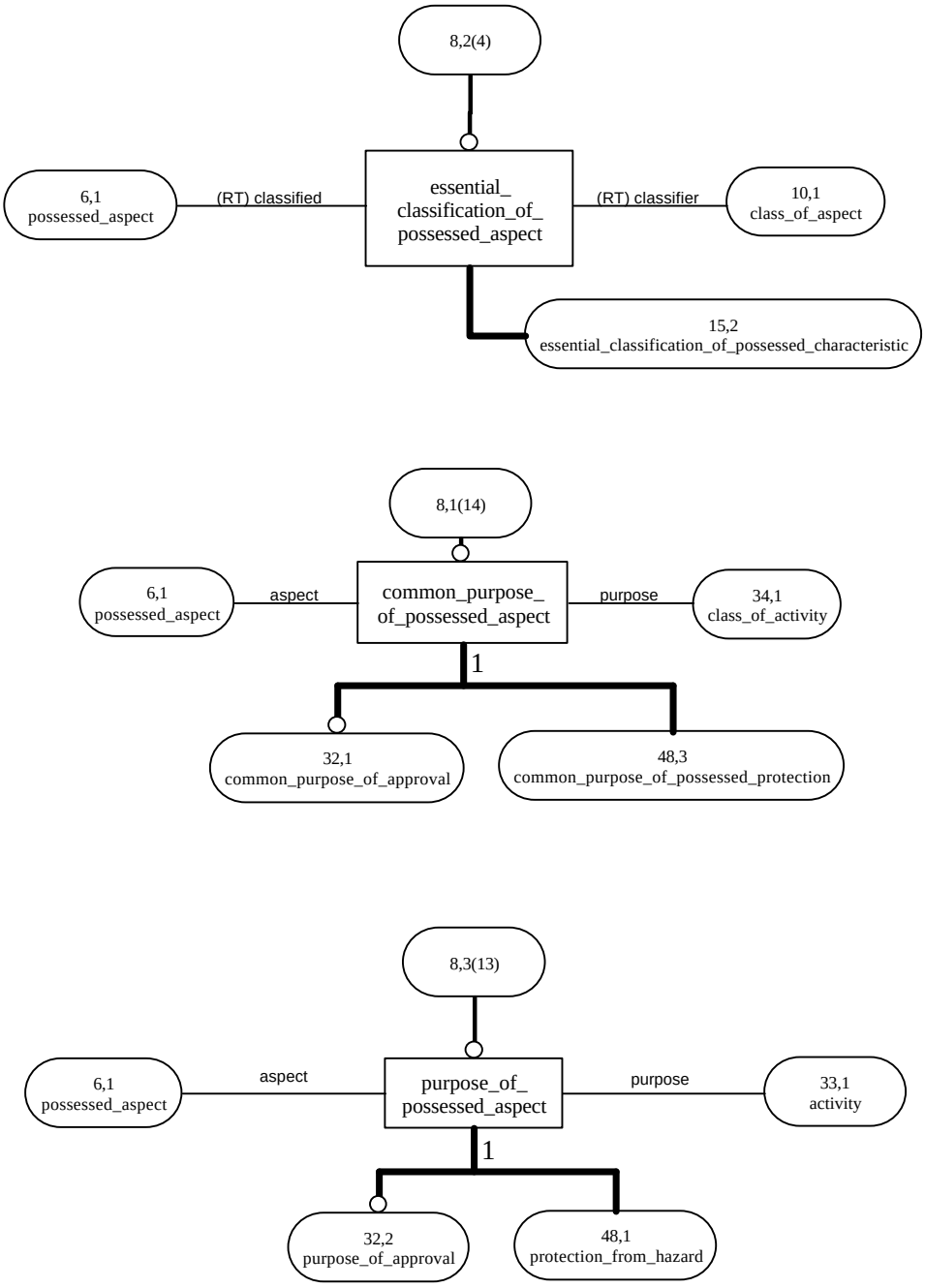


Figure 8 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed aspect (1 of 2)

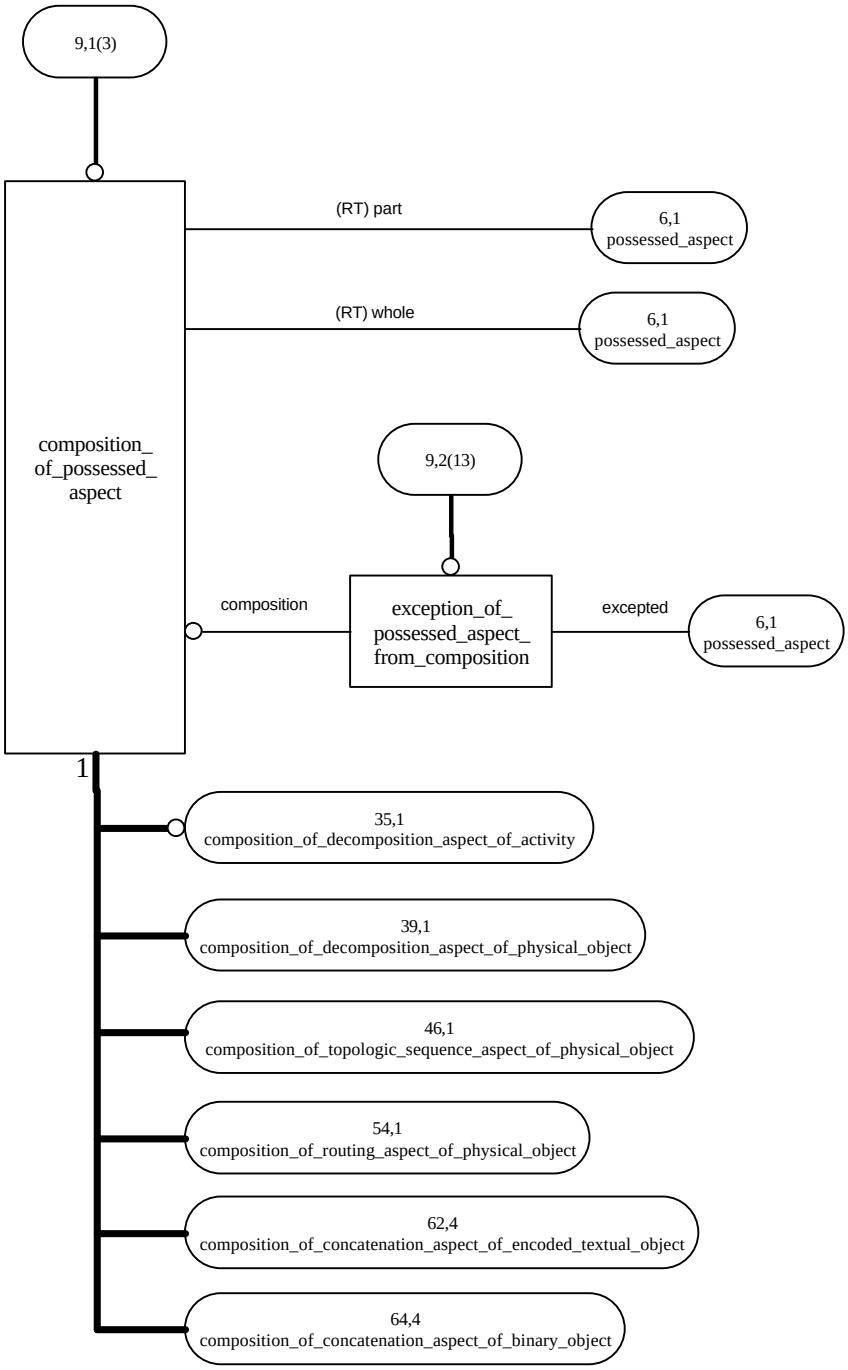


Figure 9 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed aspect (2 of 2)

7.8 Class of aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.8.1 aspect_qualifier

An Aspect_qualifier is a Class_of_aspect that indicates the circumstances in which a Possessed_aspect exists.

EXAMPLE 1 "Normal operation" is an Aspect_qualifier.

EXAMPLE 2 "Nominal" is an Aspect_qualifier.

EXPRESS specification:

```
*)
ENTITY aspect_qualifier
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.8.2 class_of_aspect

A Class_of_aspect is a Class_of_individual that is a specialisation of Possessed_aspect that indicates a common nature of possessed aspects.

EXAMPLE Electrical connection is a Class_of_aspect.

EXPRESS specification:

```
*)
ENTITY class_of_aspect
   ABSTRACT SUPERTYPE OF (ONEOF (class_of_characteristic,
                                 class_of_state,
                                 class_of_association,
                                 class_of_mathematical_object,
                                 class_of_role)
                     ANDOR aspect_qualifier
                     ANDOR ONEOF (concept_of_aspect,
                                  qualified_aspect,
                                  common_aspect))
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.8.3 common_aspect

A Common_aspect is a Class_of_aspect where the common nature of the members is some quantified value or relationships to constraining types.

EXAMPLE 1 Connection of physical object is a Common_aspect that is a connection that is restricted to physical objects.

EXAMPLE 2 Connection is not a Common_aspect, but is a Concept_of_aspect and a Concept_of_association.

EXAMPLE 3 The temperature described by 20 deg C is a Common_aspect that is a temperature that maps to the number 20 on the Centigrade scale.

EXAMPLE 4 Temperature is not a Common_aspect, but is a Concept_of_aspect and a Concept_of_characteristic.

EXPRESS specification:

```
*)
ENTITY common_aspect
   SUPERTYPE OF (ONEOF (common_association,
                        common_characteristic,
                        common_state,
                        common_mathematical_object,
                        common_decomposition_aspect_of_activity,
                        common_decomposition_aspect_of_physical_object,
                        common_topologic_sequence_aspect_of_of_physical_object,
                        common_routing_aspect_of_physical_object))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.8.4 concept_of_aspect

A Concept_of_aspect is a Class_of_aspect that identifies a generic nature of possessed aspects, excluding any quantification or enumeration of the possessed aspects.

EXAMPLE 1 Temperature is a Concept_of_aspect.

EXAMPLE 2 Shape is a Concept_of_aspect.

EXAMPLE 3 Connection is a Concept_of_aspect.

EXAMPLE 4 A temperature of a particular magnitude is both a Concept_of_aspect and a Common_aspect.

EXPRESS specification:

```
*)
ENTITY concept_of_aspect
   SUPERTYPE OF (ONEOF (concept_of_association,
                        concept_of_characteristic,
                        concept_of_state,
                        concept_of_mathematical_object))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.8.5 qualified_aspect

A Qualified_aspect is a Class_of_aspect whose members are members of an Aspect_qualifier, a Common_aspect and a Concept_of_aspect

EXAMPLE 1 "maximum operating temperature of 20 deg C" is a Qualified_aspect that is a specialization of the Aspect_qualifier "maximum operating", and the Common_aspect "temperature of 20 deg C".

EXAMPLE 2 "Electrical connection" is a Qualified_aspect that is a specialization of the Common_aspect "Connection of physical objects" and of the Aspect_qualifier "electrical".

EXPRESS specification:

```
*)
ENTITY qualified_aspect
   SUPERTYPE OF (ONEOF (qualified_association,
                        qualified_characteristic,
                        qualified_state,
                        qualified_mathematical_object))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

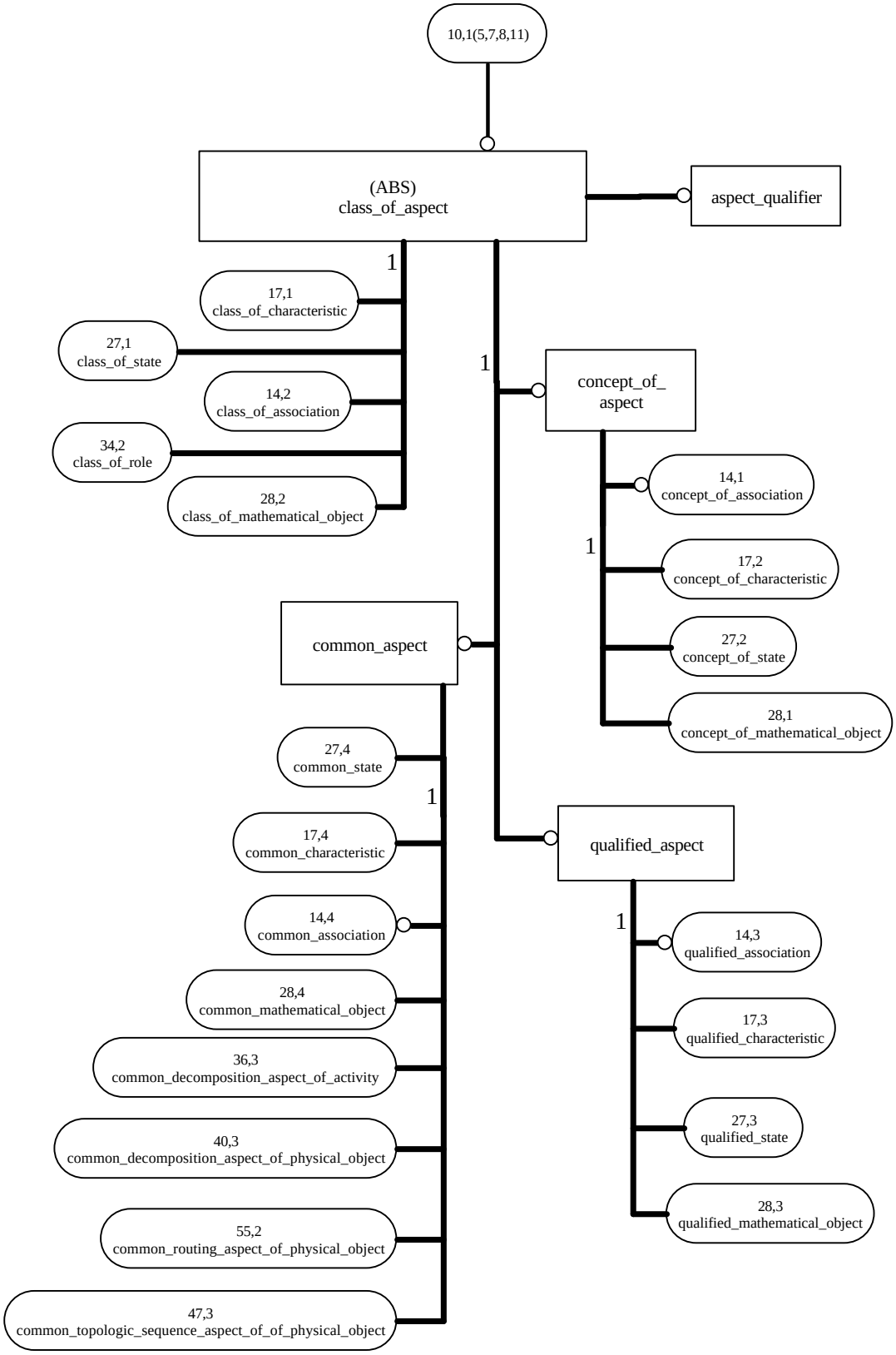


Figure 10 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of aspect

7.9 Common purpose and composition of aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.9.1 common_composition_of_aspect

A Common_composition_of_aspect is a Common_composition_of_individual that a specialization of Composition_of_possessed_aspect.

EXAMPLE The class of relationship between the Class_of_aspect "system valve operational configuration" and the Class_of_aspect "Valve openness" indicating that a valve configuration consists of one or more members of the Class_of_aspect "Valve openness" is a Common_composition_of_aspect.

EXPRESS specification:

```
*)
ENTITY common_composition_of_aspect
   SUPERTYPE OF (ONEOF (common_composition_of_decomposition_aspect_of_activity,
                        common_composition_of_decomposition_aspect_of_physical_object,
                  common_composition_of_topologic_sequence_aspect_of_physical_object,
                           common_composition_of_routing_aspect_of_physical_object))
   SUBTYPE OF (common_composition_of_individual);
   SELF\common_composition_of_individual.part  : class_of_aspect;
   SELF\common_composition_of_individual.whole : class_of_aspect;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Class_of_aspect that is part of the whole class_of_aspect.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Class_of_aspect that is the whole for the part Class_of_aspect.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.9.2 common_purpose_of_aspect

A common_purpose_of_aspect is a common_association between a Class_of_aspect and a Class_of_activity that has members of Purpose_of_possessed_aspect as members.

EXAMPLE The class of relationship between the Class_of_aspect "shape of bucket" and Class_of_activity "Hold liquid" indicating that members of the activity class may be the purpose of the members of the shape aspect class.

EXPRESS specification:

```
*)
ENTITY common_purpose_of_aspect
   SUBTYPE OF (common_association);
   aspect  : class_of_aspect;
   purpose : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Class_of_aspect whose members allow involvement with members of the activity class.

The aspect role corresponds to role_1 of the Common_association cardinality data.

purpose: The purpose specifies the Class_of_activity whose members are the reason for the existence of the members of Class_of_aspect.

The purpose role corresponds to role_2 of the Common_association cardinality data.

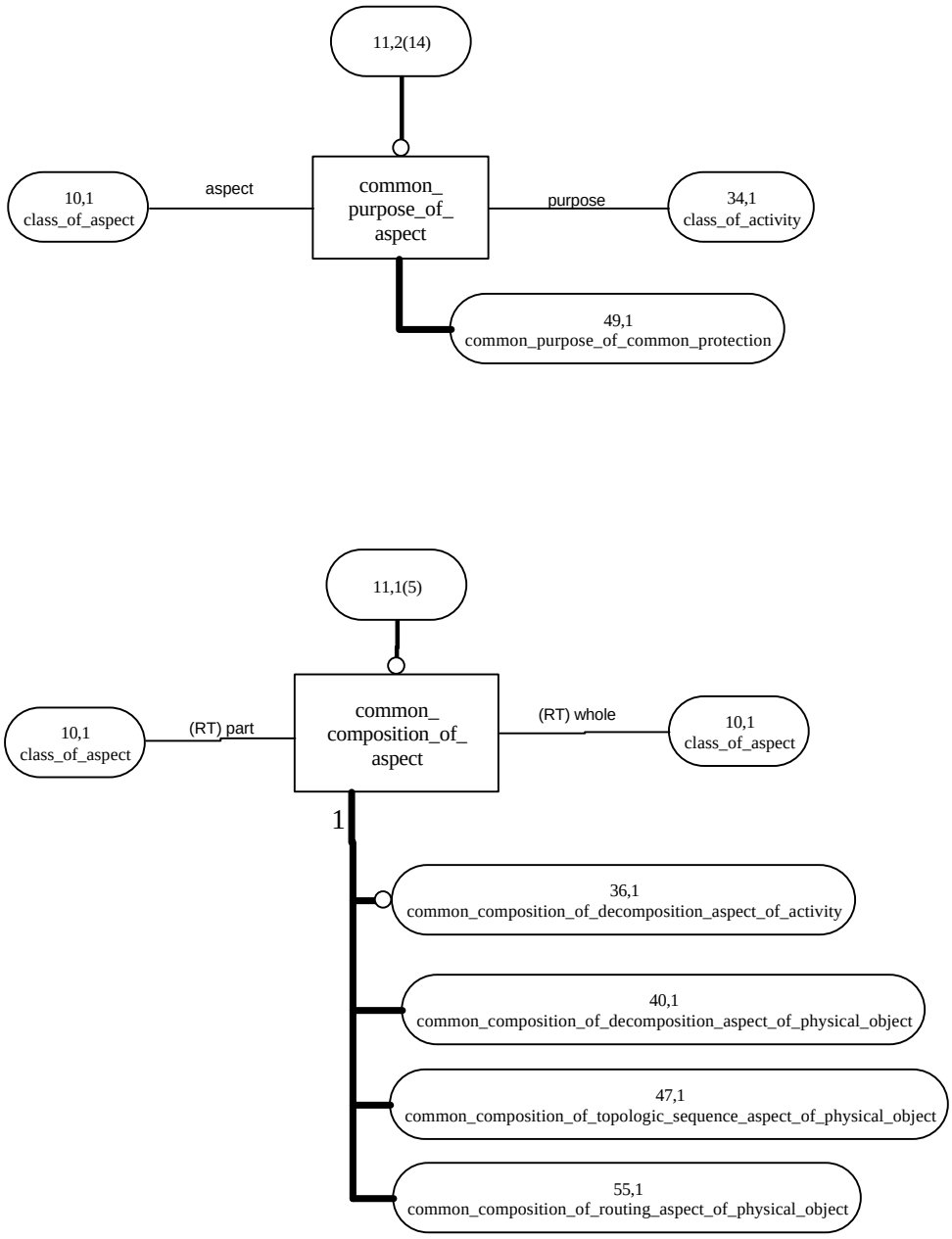


Figure 11 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common purpose and composition of aspect

7.10 Fulfilment of aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.10.1 fulfilment_of_possessed_aspect

A Fulfilment_of_possessed_aspect is a Possessed_association that links different lifecycle Possessed_aspects and indicates the fulfilled Possessed_aspect is the expectation or reason for the fulfiller Possessed_aspect.

EXPRESS specification:

```
*)
ENTITY fulfilment_of_possessed_aspect
   ABSTRACT SUPERTYPE OF
   (ONEOF (fulfilment_of_possessed_predicted_aspect_by_actual,
           fulfilment_of_possessed_required_aspect_by_actual,
           fulfilment_of_possessed_required_aspect_by_planned,
           fulfilment_of_possessed_planned_aspect_by_actual))
   SUBTYPE OF (possessed_association);
   fulfilled : possessed_aspect;
   fulfiller : possessed_aspect;
END_ENTITY;
(*
```

Attribute definitions:

fulfilled: The fulfilled specifies the Possessed_aspect that is fulfilled by the fulfiller.

fulfiller: The fulfiller specifies the Possessed_aspect that is fulfilling the fulfilled.

7.10.2 fulfilment_of_possessed_planned_aspect_by_actual

A Fulfilment_of_possessed_planned_aspect_by_actual is a Fulfilment_of_possessed_aspect that indicates the Possessed_actual_aspect has been created or selected according to the Possessed_planned_aspect, but is not necessarily consistent with or a satisfaction of the Possessed_planned_aspect.

EXAMPLE A Vessel has a Possessed_planned_aspect that is a wall thickness between 2.52 and 2.55cm and after manufacture a Possessed_actual_aspect wall thickness of 2.50 cm. The relationship between the planned thickness and the actual thickness is a Fulfilment_of_possessed_planned_aspect_by_actual.

EXPRESS specification:

```
*)
ENTITY fulfilment_of_possessed_planned_aspect_by_actual
   SUBTYPE OF (fulfilment_of_possessed_aspect);
   SELF\fulfilment_of_possessed_aspect.fulfilled : possessed_planned_aspect;
   SELF\fulfilment_of_possessed_aspect.fulfiller : possessed_actual_aspect;
END_ENTITY;
(*
```

Attribute definitions:

fulfilled: The fulfilled specifies the Possessed_planned_aspect that fulfilled by the fulfiller.

fulfiller: The fulfiller specifies the Possessed_actual_aspect that is fulfilling the fulfilled.

7.10.3 fulfilment_of_possessed_predicted_aspect_by_actual

A Fulfilment_of_possessed_predicted_aspect_by_actual is a Fulfilment_of_possessed_aspect that indicates the Possessed_actual_aspect is what the Possessed_predicted_aspect was about, but is not necessarily consistent with the prediction.

EXAMPLE The actual Vessel XYZ_1234 has a possessed_predicted_aspect of wall thickness of 2.4mm after 10000 operating hours. The actual wall thickness, measured at 10000 hrs is 2.43mm.The relationship between the predicted thickness and the actual thickness is a Fulfilment_of_possessed_predicted_aspect_by_actual.

EXPRESS specification:

```
*)
ENTITY fulfilment_of_possessed_predicted_aspect_by_actual
   SUBTYPE OF (fulfilment_of_possessed_aspect);
   SELF\fulfilment_of_possessed_aspect.fulfilled : possessed_predicted_aspect;
   SELF\fulfilment_of_possessed_aspect.fulfiller : possessed_actual_aspect;
END_ENTITY;
(*
```

Attribute definitions:

fulfilled: The fulfilled specifies the Possessed_predicted_aspect that is a prediction for the Possessed_actual_aspect.

fulfiller: The fulfiller specifies the Possessed_actual_aspect that is the prediction of a Possessed_predicted_aspect.

7.10.4 fulfilment_of_possessed_required_aspect_by_actual

A Fulfilment_of_possessed_required_aspect_by_actual is a Fulfilment_of_possessed_aspect that indicates the Possessed_actual_aspect is a response to the Possessed_required_aspect , but may or may not conform to the requirement.

EXAMPLE The actual Vessel XYZ_1234 has possessed_required_aspect wall thickness of between 2.5mm and 2.6mm. The actual wall thickness is measured to be 2.52mm. The relationship between the required thickness and the actual thickness is a Fulfilment_of_possessed_required_aspect_by_actual.

EXPRESS specification:

```
*)
ENTITY fulfilment_of_possessed_required_aspect_by_actual
   SUBTYPE OF (fulfilment_of_possessed_aspect);
   SELF\fulfilment_of_possessed_aspect.fulfilled : possessed_required_aspect;
   SELF\fulfilment_of_possessed_aspect.fulfiller : possessed_actual_aspect;
END_ENTITY;
(*
```

Attribute definitions:

fulfilled: The fulfilled specifies the Possessed_required_aspect that is a requirement that resulted in the Possessed_actual_aspect.

fulfiller: The fulfiller specifies the Possessed_actual_aspect that is a response to the fulfiller Possessed_required_aspect. The fulfiller may or may not satisfy the fulfilled requirement.

7.10.5 fulfilment_of_possessed_required_aspect_by_planned

A Fulfilment_of_possessed_required_aspect_by_planned is a Fulfilment_of_possessed_aspect that indicates the Possessed_required_aspect the Possessed_planned_aspect was created or selected in response to, but not necessarily meeting the requirement.

EXAMPLE The Vessel XYZ_1234 has a possessed_required_aspect of wall thickness of between 2.5mm and 2.6mm. To meet this requirement, the Vessel maker defined a possessed_planned_aspect wall thickness of between 2.52 and 2.55mm.The relationship between the planned thickness and the required thickness is a Fulfilment_of_possessed_required_aspect_by_planned.

EXPRESS specification:

```
*)
ENTITY fulfilment_of_possessed_required_aspect_by_planned
   SUBTYPE OF (fulfilment_of_possessed_aspect);
   SELF\fulfilment_of_possessed_aspect.fulfilled : possessed_required_aspect;
   SELF\fulfilment_of_possessed_aspect.fulfiller : possessed_planned_aspect;
END_ENTITY;
(*
```

Attribute definitions:

fulfilled: The fulfilled specifies the Possessed_required_aspect that the fulfiller Possessed_planned_aspect is a response to. The fulfiller may or may not satisfy the fulfilled requirement.

fulfiller: The fulfiller specifies the Possessed_planned_aspect that is fulfilling the fulfilled.

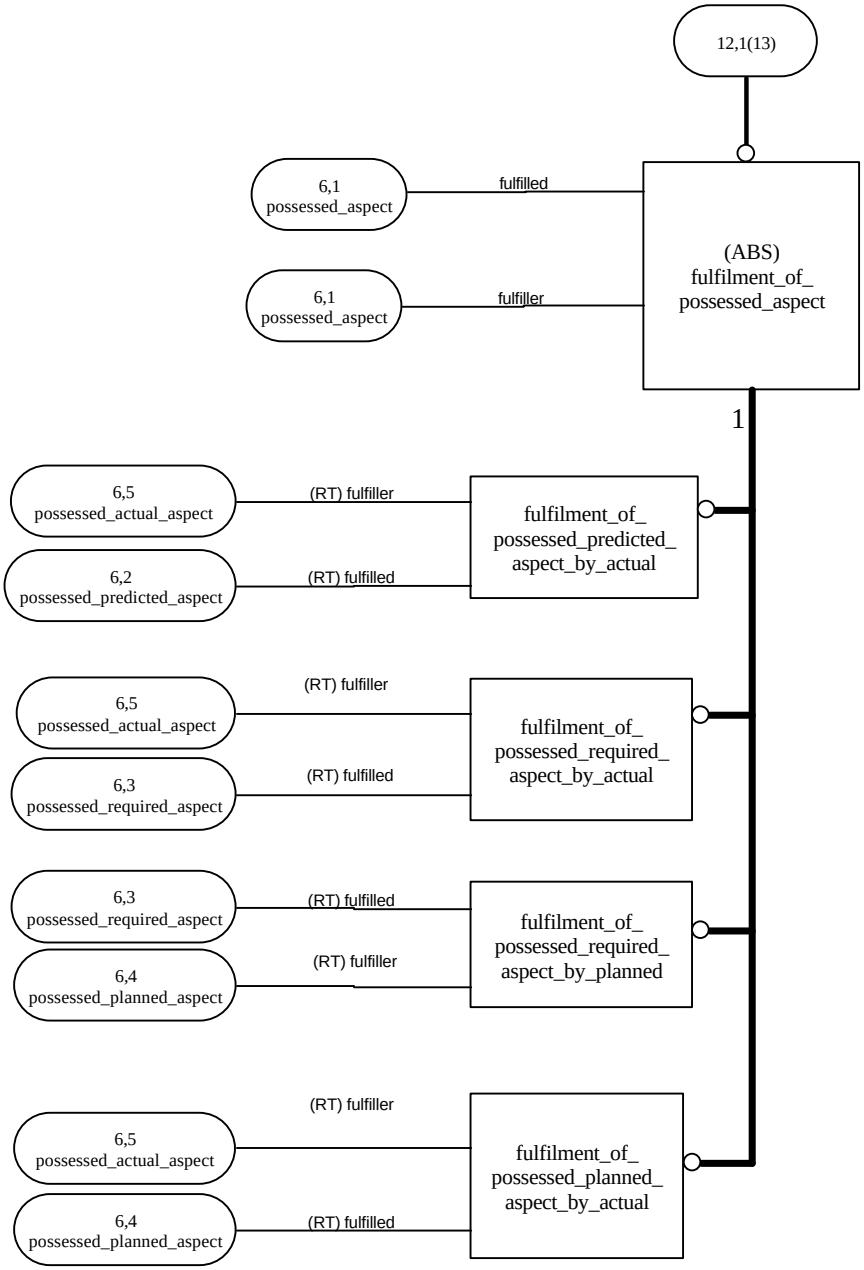


Figure 12 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Fulfilment of aspect

7.11 Possessed association

A description of the uses of the entity types shown in this section will go here, eventually.

7.11.1 essential_classification_of_possessed_association

An Essential_classification_of_possessed_association is an Essential_classification_of_possessed_aspect that indicates a Possessed_association is a member of a Class_of_association.

EXAMPLE The relationship between an Possessed_association and the Class_of_association "connection" indicating that the relationship is a connection relationship is an Essential_classification_of_possessed_association.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_possessed_association
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : possessed_association;
   SELF\classification_of_individual.classifier : class_of_association;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Possessed_association that is a member of the classifier class.

classifier: The classifier specifies the class_of_association that the classified association is a member of.

7.11.2 possessed_asserting_association

A Possessed_asserting_association is a Possessed_association that indicates that the member relationships describe that which is, in contrast to that which is not.

EXAMPLE The classification of a batch of petroleum distillate that is Gasoline is a Possessed_actual_aspect and a Possessed_asserting_association.

EXPRESS specification:

```
*)
ENTITY possessed_asserting_association
   SUBTYPE OF (possessed_association);
END_ENTITY;
(*
```

7.11.3 possessed_association

A possessed_association is a Possessed_aspect that is a relationship between two application_objects.

A Possessed_association is an Individual and may possess aspects.

A Possessed_association may also be a member of the life cycle possessed aspect classes.

EXPRESS specification:

```
*)
ENTITY possessed_association
   ABSTRACT SUPERTYPE OF (ONEOF (classification,
                                 custody_of_class_definition,
                                 composition_of_individual,
                                 purpose_of_possessed_aspect,
                                 exception_of_possessed_aspect_from_composition,
                                 fulfilment_of_possessed_aspect,
                                 derivation_of_possessed_characteristic,
                                 composition_of_possessed_characteristic,
                                 comparison_of_characteristic_with_reference,
                                 bounding_of_possessed_spatial_aspect,
                                 start_point_in_time_of_possessed_period_of_time,
                                 end_point_in_time_of_possessed_period_of_time,
                                 description_of_object_by_encoded_information,
                                 change_of_possessed_state,
                                 uniqueness_context_for_identification,
                                 registration_of_identification_with_organisation,
                                 identification_of_object_by_encoded_information,
                                 version_association_between_objects,
                                 succession_association_between_objects,
                                 alternative_association_between_objects,
                                 derivation_association_between_objects,
                                 involvement_of_object_in_activity,
                                 temporal_sequence_of_activity,
                    installation_of_physical_object_for_functional_physical_object,
                                 connection_of_physical_object,
                                 usage_of_physical_object_in_connection,
                                 connector_of_physical_object,
                                 physical_feature_of_physical_object,
                                 relative_placement_of_physical_object,
                                 segregation_of_physical_object,
                              usage_of_intermediate_physical_object_for_segregation,
                                 topologic_sequence_of_physical_object,
                                 protection_of_physical_object,
                                 redundancy_of_physical_object,
                                representative_association_between_physical_objects,
                           role_of_person_or_organization_in_life_of_physical_object,
                                 physical_object_following_route,
                                 source_of_route,
                                 destination_of_route,
                                 place_of_residence_of_organization,
                                 representation_of_organization,
                                 place_of_residence_of_person,
                                 employment_of_person,
                                 assignment_of_person,
                                 representation_of_person,
                                 description_of_object_via_information,
                                 reference_to_object_within_information,
                                 expression_of_information_by_encoded_information,
                                 symbolization_of_object_by_encoded_information,
                                 reference_to_object_within_encoded_information,
                              presentation_of_encoded_information_by_physical_object,
                                 concatenation_of_textual_object,
                                 replacement_of_textual_object,
                                 concatenation_of_binary_object,
                                 symbolization_of_object_by_physical_object,
                                 description_of_object_via_physical_object,
                                 reference_to_object_within_physical_object,
                                 approval_of_object)
                    ANDOR ONEOF (possessed_asserting_association,
                                 possessed_denying_association,
                                 possessed_probalistic_association))
   SUBTYPE OF (possessed_aspect);
```

```
END_ENTITY;
(*
```

7.11.4 possessed_denying_association

A Possessed_denying_association is a Possessed_association that indicates that the member relationships describe that which is not, in contrast to that which is.

EXAMPLE The classification of a batch of petroleum distillate that is 'off-spec' for Gasoline is a Possessed_actual_aspect and a Possessed_denying_association.

EXPRESS specification:

```
*)
ENTITY possessed_denying_association
   SUBTYPE OF (possessed_association);
END_ENTITY;
(*
```

7.11.5 possessed_probalistic_association

A Possessed_probalistic_association is a Possessed_association that indicates that the member relationships describe that which is possible, in contrast to that which is or which is not.

EXAMPLE The classification of a batch of petroleum distillate that might be Gasoline is a Possessed_actual_aspect and a Possessed_probalistic_association.

EXPRESS specification:

```
*)
ENTITY possessed_probalistic_association
   SUBTYPE OF (possessed_association);
END_ENTITY;
(*
```

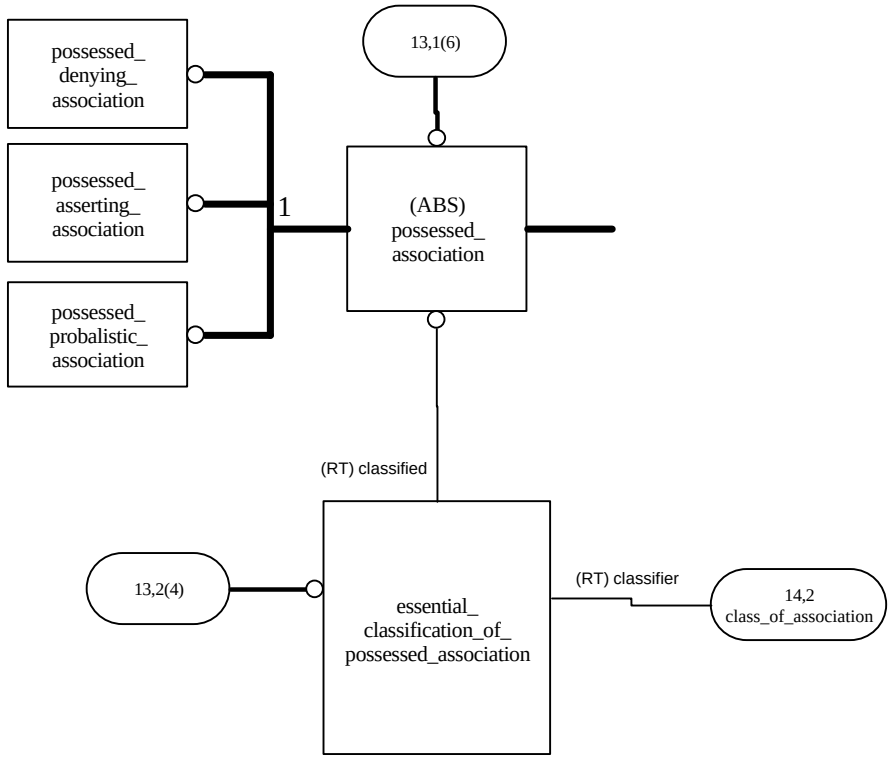


Figure 13 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed association

7.12 Class of association

A description of the uses of the entity types shown in this section will go here, eventually.

7.12.1 class_of_association

A Class_of_association is a Class_of_aspect that has members of Possessed_association as members.

EXAMPLE The associations that indicate that nozzles are connected to pipe flanges is a Class_of_association "nozzle to pipe flange connections".

EXPRESS specification:

```
*)
ENTITY class_of_association
   SUPERTYPE OF (ONEOF (concept_of_association,
                        qualified_association,
                        common_association)
            ANDOR class_of_scale)
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.12.2 common_asserting_association

A Common_asserting_association is a Common_association that is a specialization of Possessed_asserting_association that indicates a common nature of possessed asserting associations.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_asserting_association
   SUBTYPE OF (common_association);
END_ENTITY;
(*
```

7.12.3 common_association

A Common_association is a Class_of_association and a Common_aspect that associates two Application_objects and has possessed associations as members. Each associated Application_object can be either a Class or an Individual.

EXAMPLE 1 The class of associations between members of the Class "Pump model 10", manufactured by J Bloggs Pump Co., and the Organisation J Bloggs Pump Co. is a Common_association.

EXAMPLE 2 The class of associations between members of the class "Car with radio" and the class "radio", indicating every member of the car with radio class has a part which is a member of the radio class, is a common_association.

EXPRESS specification:

```
*)
ENTITY common_association
   ABSTRACT SUPERTYPE OF (ONEOF (specialization_of_class,
                                 common_composition_of_individual,
                                 common_possession_of_characteristic,
                                 common_possession_of_state,
                                 common_possession_of_identification_aspect,
                                 common_purpose_of_possessed_aspect,
                                 common_derivation_of_characteristic,
                                 common_composition_of_characteristic,
                                comparison_of_common_characteristic_with_reference,
                                 common_scale,
                                 common_scale_valuation,
                                 common_encoded_scale_valuation,
                               common_start_point_in_time_of_common_period_in_time,
                                 common_end_point_in_time_of_common_period_in_time,
                     description_of_common_point_in_time_by_encoded_date_and_time,
                                 common_change_of_state,
                                 common_possession_of_temporal_aspect_by_state,
                                 mathematical_function,
                                 common_purpose_of_aspect,
                                 common_role_in_activity,
                                 common_role_of_object,
                                 common_temporal_sequence_of_activity,
                             common_possession_of_decomposition_aspect_of_activity,
            common_installation_of_physical_object_for_functional_physical_object,
                       common_possession_of_decomposition_aspect_by_physical_object,
            connection_of_physical_object_with_member_of_class_of_physical_object,
                          usage_of_member_of_class_of_physical_object_in_connection,
                    possession_of_member_of_class_of_physical_object_as_connector,
                                 possession_of_member_of_class_of_physical_feature,
                                 common_connection_of_physical_object,
                                 common_usage_of_physical_object_in_connection,
                                 common_connector_of_physical_object,
                                 common_physical_feature_of_physical_object,
                                 common_relative_placement_of_physical_object,
                                 common_segregation_of_physical_object,
                     common_usage_of_intermediate_physical_object_for_segregation,
                                 description_of_common_spatial_aspect,
                 common_possession_of_topologic_sequence_aspect_by_physical_object,
                                 common_topologic_sequence_of_physical_object,
                                 common_protection_of_physical_object,
                                 common_redundancy_of_physical_object,
                           common_representative_association_between_physical_object,
     role_of_person_or_organization_in_life_of_members_of_class_of_physical_object,
                  common_role_of_person_or_organization_in_life_of_physical_object,
                                 common_physical_object_following_route,
                                 common_source_of_route,
                                 common_destination_of_route,
                              common_possession_of_routing_aspect_of_physical_object,
                                      common_description_of_object_via_information,
                                      common_reference_to_object_within_information,
                                common_expression_of_information_by_encoded_information,
                   presentation_of_class_of_encoded_information_by_physical_object,
                                 common_symbolization_of_object_by_physical_object,
                                 common_description_of_object_via_physical_object,
                                 common_reference_to_object_within_physical_object,
            common_presentation_of_class_of_encoded_information_by_physical_object)
                    ANDOR ONEOF (common_denying_association,
                                 common_asserting_association,
                                 common_probalistic_association))
   SUBTYPE OF (class_of_association,
               common_aspect);
   role_1_life_cardinality         : numeric_range_by_bounds;
```

```
   role_2_life_cardinality         : numeric_range_by_bounds;
   role_1_simultaneous_cardinality : numeric_range_by_bounds;
   role_2_simultaneous_cardinality : numeric_range_by_bounds;
   associativety : BOOLEAN;
END_ENTITY;
(*
```

Attribute definitions:

role_1_life_cardinality: The role_1_life_cardinality specifies the maximum and minimum number of members of the Common_association class that involve the individual or a member of the class specified by role_1 that can exist over the life of the individual or member.

role_2_life_cardinality: The role_2_life_cardinality specifies the maximum and minimum number of members of the Common_association class that involve the individual or a member of the class specified by role_2 that can exist over the life of the individual or member.

role_1_simultaneous_cardinality: The role_1_simultaneous_cardinality specifies the maximum and minimum number of members of the Common_association class that involve the individual or a member of the class specified by role_1 that can exist at the same time for the individual or member.

role_2_simultaneous_cardinality: The role_2_simultaneous_cardinality specifies the maximum and minimum number of members of the Common_association class that involve the individual or a member of the class specified by role_2 that can exist at the same time for the individual or member.

associativety: The role_1_associativety specifies either true or false. True indicates that members of the role_1 class is associated with all members of role_2 class and that members of the role_2 class are associated with all members of the role_1 class. False indicates that neither apply.

7.12.4 common_denying_association

A Common_denying_association is a Common_association that is a specialization of Possessed_denying_association that indicates a common nature of possessed denying associations.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_denying_association
   SUBTYPE OF (common_association);
END_ENTITY;
(*
```

7.12.5 common_probalistic_association

A Common_probalistic_association is a Common_association that is a specialization of Possessed_probalistic_association that indicates a common nature of possessed probalistic associations.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_probalistic_association
   SUBTYPE OF (common_association);
END_ENTITY;
(*
```

7.12.6 concept_of_association

A Concept_of_association is a Class_of_association and a Concept_of_aspect that indicates a generic nature of a member Possessed_association. It does not specify the members that are associated by the Possessed_association members.

EXAMPLE "Signal connection" is a Concept_of_association

EXPRESS specification:

```
*)
ENTITY concept_of_association
   SUBTYPE OF (class_of_association,
               concept_of_aspect);
END_ENTITY;
(*
```

7.12.7 qualified_association

A qualified_association is a Class_of_association and a Qualified_aspect. A qualified_association has members which are members of a Common_association and of an Aspect_qualifier.

EXAMPLE The Connection_of_physical_object between Level Controller 501 and Flow controller A is member of the Qualified_association "normal operation instrument connection". This class is a specialization of the Aspect_qualifier "normal operation".

EXPRESS specification:

```
*)
ENTITY qualified_association
   SUBTYPE OF (class_of_association,
               qualified_aspect);
END_ENTITY;
(*
```

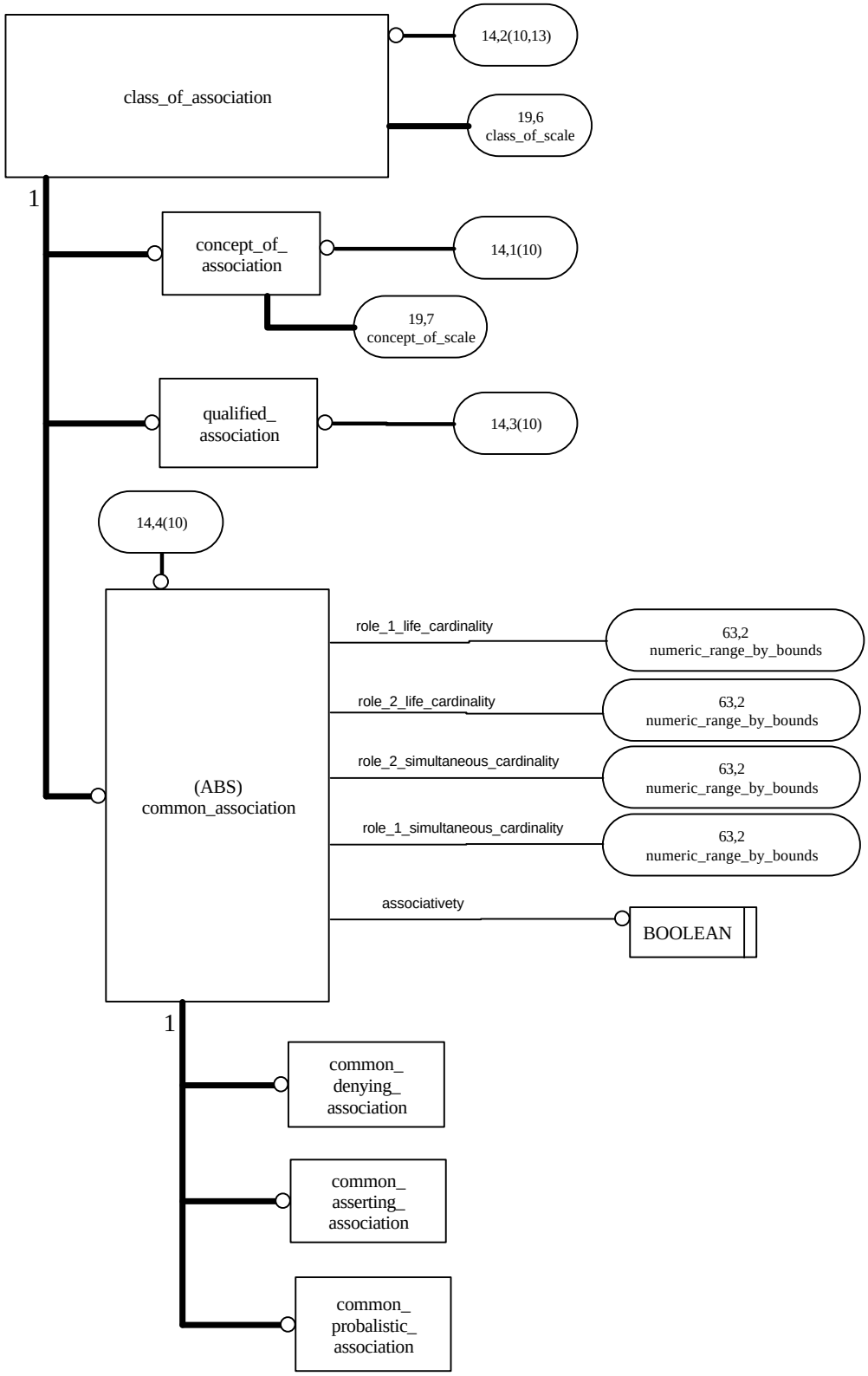


Figure 14 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of association

7.13 Possessed characteristic

A description of the uses of the entity types shown in this section will go here, eventually.

7.13.1 composition_of_possessed_characteristic

A Composition_of_possessed_characteristic is a Possessed_association that indicates each member pf the LIST of possessed_characteristic is a part of the whole possessed_characteristic.

The order of the LIST has no significance. A LIST with several members is equivalent to several Composition_of_possessed_characteristic.

EXAMPLE The relationship between the possessed pressure difference & flow rate characteristic and its two parts a possessed pressure difference that is 15 bar and a possessed flow rate that is 16 dm3 sec-1, is a Composition_of_possessed_characteristic.

EXPRESS specification:

```
*)
ENTITY composition_of_possessed_characteristic
   SUBTYPE OF (possessed_association);
   part  : LIST [1:?] OF possessed_characteristic;
   whole : possessed_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies a list of members of Possessed_characteristic that are all parts of the whole.

whole: The whole specifies the Possessed_characteristic that is the whole for the part LIST.

7.13.2 derivation_of_possessed_characteristic

A Derivation_of_possessed_characteristic is a Possessed_association that indicates that the derived Possessed_characteristic depends on the Possessed_characteristics of the source LIST.

Dependencies may arise from laws of nature or from design requirements.

EXAMPLE The relationship between the Possessed_property that is the planned flow velocity of fluid in a valve and the planned flow rate and the actual valve diameter properties indicating the flow velocity is dependent on the flow rate and valve diameter is a Derivation_of_possessed_characteristic .

EXPRESS specification:

```
*)
ENTITY derivation_of_possessed_characteristic
   SUBTYPE OF (possessed_association);
   derivative : possessed_characteristic;
   source     : LIST [1:?] OF possessed_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

derivative: The derivative specifies the Possessed_characteristic that depends on the source LIST of Possessed_characteristic.

source: The source specifies the LIST of Possessed_characteristic instances that the derivative Possessed_characteristic depends on.

7.13.3 essential_classification_of_possessed_characteristic

An Essential_classification_of_possessed_characteristic is an Essential_classification_of_possessed_aspect that classifies a Possessed_characteristic.

EXAMPLE The the relationship between the Possessed_characteristic that is the internal pressure of Vessel-4506 and the Class_of_characteristic that is an internal pressure that indicates the property is an internal pressure is an Essential_classification_of_possessed_characteristic. The maximum of the internal pressure of Vessel-4506 is a Possessed_characteristic of the possessed internal pressure which may be essentially classified as a maximum.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_possessed_characteristic
   SUBTYPE OF (essential_classification_of_possessed_aspect);
   SELF\essential_classification_of_possessed_aspect.classified :
       possessed_characteristic;
   SELF\essential_classification_of_possessed_aspect.classifier :
       class_of_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Possessed_characteristic that is the member of the classifier Class_of_characteristic.

classifier: The classifier specifies the Class_of_characteristic that has the classified as a member.

7.13.4 incidental_classification_of_possessed_characteristic

An Incidental_classification_of_possessed_characteristic is an Incidental_classification_of_individual that classifies a Possessed_characteristic by a value indicated by the Common_characteristic. An Incidental_classification_of_individual may start and stop enabling a possessed property to have several values from time to time.

EXAMPLE The the relationship between the Possessed_characteristic that is the internal pressure of Vessel-4506 and the Class_of_characteristic that is an internal pressure of value 23.6 bars that indicates the property has a value of 23.6 bar is an Incidental_classification_of_possessed_characteristic.

EXPRESS specification:

```
*)
ENTITY incidental_classification_of_possessed_characteristic
   SUBTYPE OF (incidental_classification_of_individual);
   SELF\classification_of_individual.classified : possessed_characteristic;
   SELF\classification_of_individual.classifier : common_characteristic;
END_ENTITY;
(*
```

7.13.5 possessed_atomic_and_subatomic_structure

A possessed_atomic_and_subatomic_structure is a Possessed_quality that is the type and arrangement of the atoms of a material.

EXAMPLE 1 The material of construction of the body of the stainless steel Valve-1022 is a Possessed_atomic_and_subatomic_structure possessed by the valve body that is essentially classified as stainless steel.

EXAMPLE 2 The material of a stream of water is a Possessed_atomic_and_subatomic_structure, possessed by the stream that is essentially classified as being water.

EXAMPLE 3 The surface coating material is a Possessed_atomic_and_subatomic_structure possessed by the surface feature that is essentially classified as being zinc.

EXAMPLE 4 The cross grain arrangement of wood of laminated boards is a Possessed_atomic_and_subatomic_structure.

EXPRESS specification:

```
*)
ENTITY possessed_atomic_and_subatomic_structure
   SUBTYPE OF (possessed_quality);
END_ENTITY;
(*
```

7.13.6 possessed_characteristic

A Possessed_characteristic is an Aspect_possessed_by_individual that is something that can be observed or measured; or that is a requirement, plan or prediction for something that can be measured or observed.

A Possessed_characteristic is an intrinsic part of the thing it is possessed by. It is possessed by only one thing. The essential nature of the Possessed_characteristic is indicated by Essential_classification_of_possessed_characteristic.

The result of the an observation or measurement of a Possessed_characteristic is recorded using Incidental_classification_of_possessed_characteristic to reference one or more Common_characteristic.

The magnitude of a Possessed_characteristic may vary with time, giving several incidental classification associations, each restricted to the relevant time.

A Possessed_characteristic may also be a possessed_predicted_aspect, a possessed_required_aspect, a possessed_planned_aspect, or a Possessed_actual_aspect.

EXAMPLE 1 Two vessels each have their own actual temperature, each vessel temperature is a different Possessed_charcteristic.

EXAMPLE 2 The planned normal operating pressure for Vessel-4506 is a Possessed_characteristic and a Possessed_planned_aspect. The characteristic is possessed by the planned Vessel-4506, which is a Physical_object and a Possessed_planned_aspect of the whole Vessel-4506.

EXAMPLE 3 The actual operating pressure for Vessel V-4506 is a Possessed_characteristic and a Possessed_actual_aspect. The characteristic is possessed by the actual Vessel-4506, which is a Physical_object and a Possessed_actual_aspect.

EXAMPLE 4 The actual shape of the vessel V-4506 is a possessed_characteristic and a Possessed_spatial_aspect of the vessel.

EXAMPLE 5 The time of operation of the V-4506 is a Possessed_characteristic and a Possessed_temporal_aspect of the vessel.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic
   SUPERTYPE OF (ONEOF (possessed_property,
                        possessed_spatial_aspect,
                        possessed_temporal_aspect,
                        possessed_count,
                        possessed_quality))
   SUBTYPE OF (aspect_possessed_by_individual);
END_ENTITY;
(*
```

7.13.7 possessed_count

A Possessed_count is a Possessed_characteristic that is the number of parts of a plural individual.

EXAMPLE The number of pumps in Blow down unit 4500 is a Possessed_count.

EXPRESS specification:

```
*)
ENTITY possessed_count
   SUBTYPE OF (possessed_characteristic);
END_ENTITY;
(*
```

7.13.8 possessed_phase

A Possessed_phase is a Possessed_quality that is the nature of the boundary of the material resulting from the atomic and molecular bonding.

EXAMPLE The solidness of this material is a Possessed_phase.

EXPRESS specification:

```
*)
ENTITY possessed_phase
   SUBTYPE OF (possessed_quality);
END_ENTITY;
(*
```

7.13.9 possessed_property

A Possessed_property is a Possessed_characteristic that is not the occupation of time and space (and the other subtypes of Possessed_characteristic).

EXAMPLE 1 Absorptivity, absorption factor -- ((physics) the property of a body that determines the fraction of the incident radiation or sound flux absorbed or absorbable by the body)

EXAMPLE 2 Inductance, induction -- ((physics) a property of an electric circuit by which an electromotive force is induced in it by a variation of current)

EXAMPLE 3 Dissolubility, solubleness -- (the property of being dissoluble; "the measure the dissolubility of sugar in water")

EXAMPLE 4 Reflection, reflexion, reflectivity -- (the ability to reflect beams or rays)

EXAMPLE 5 Echo, reverberation, sound reflection -- (the persistence of a sound after its source has stopped)

EXAMPLE 6 Windage, wind deflection -- (the deflection of a projectile resulting from the effects of wind)

EXAMPLE 7 Refractivity, refractiveness -- (the physical property of a medium as determined by its index of refraction)

EXAMPLE 8 Temperature -- (the degree of hotness or coldness of a body or environment (corresponding to its molecular activity))

EXPRESS specification:

```
*)
ENTITY possessed_property
   SUBTYPE OF (possessed_characteristic);
END_ENTITY;
(*
```

7.13.10 possessed_quality

A Possessed_quality is a Possessed_characteristic that is a member of a Class_of_quality.

EXAMPLE: ??

EXPRESS specification:

```
*)
ENTITY possessed_quality
   SUPERTYPE OF (ONEOF (possessed_atomic_and_subatomic_structure,
                        possessed_phase))
   SUBTYPE OF (possessed_characteristic);
END_ENTITY;
(*
```

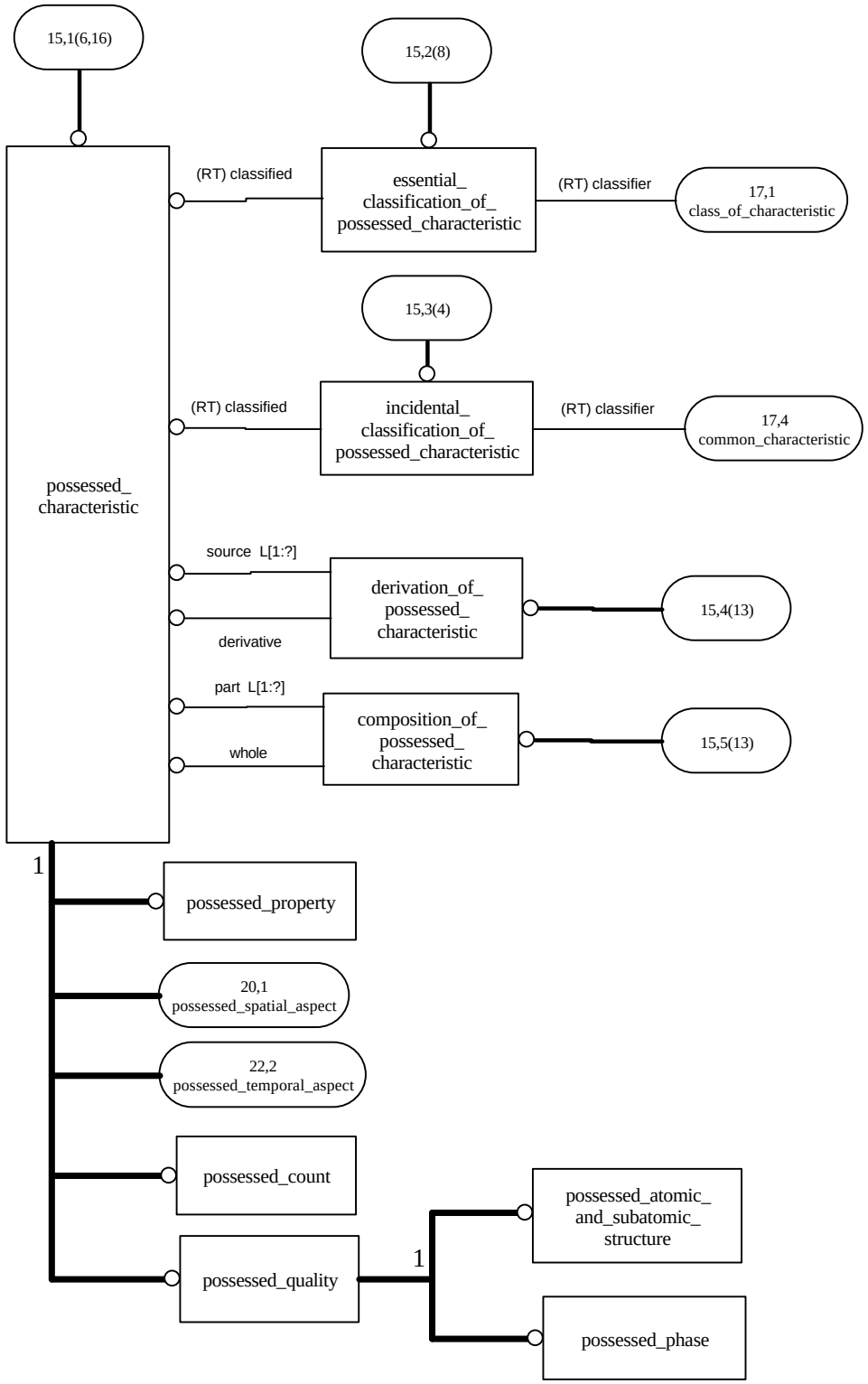


Figure 15 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed characteristic

7.14 Characteristic comparison

A description of the uses of the entity types shown in this section will go here, eventually.

7.14.1 comparison_of_characteristic_with_reference

A comparison_of_characteristic_with_reference is a Possessed_association that is the comparison of two instances of Possessed_characteristic that indicates their relative degree, magnitude or extent. The comparison is as stated for the lifetime of the comparison association.

EXPRESS specification:

```
*)
ENTITY comparison_of_characteristic_with_reference
   SUPERTYPE OF (ONEOF (possessed_characteristic_approximate_equality,
                        possessed_characteristic_inside,
                        possessed_characteristic_overlap,
                        possessed_characteristic_outside,
                        possessed_characteristic_better,
                        possessed_characteristic_worse,
                        possessed_characteristic_equality,
                        possessed_characteristic_greater_than,
                        possessed_characteristic_greater_than_or_equal_to,
                        possessed_characteristic_less_than,
                        possessed_characteristic_less_than_or_equal_to,
                        possessed_characteristic_not_equal))
   SUBTYPE OF (possessed_association);
   compared : possessed_characteristic;
   referred : possessed_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

compared: The compared specifies the Possessed_characteristic that is compared to the referred Possessed_characteristic.

referred: The referred specifies the Possessed_characteristic that the compared is being compared to.

7.14.2 possessed_characteristic_approximate_equality

A Possessed_characteristic_approximate_equality is a Comparison_of_characteristic_with_reference that indicates the magnitudes of the compared and referred are similar. The degree of similarity is not stated.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "shipping weight of the pump" indicating they are similar, is a possessed_characteristic_approximate_equality.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_approximate_equality
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.3 possessed_characteristic_better

A Possessed_characteristic_better is a Comparison_of_characteristic_with_reference that indicates the compared characteristic is better than the referred characteristic. Better is a qualitative judgement made with no measurable criteria.

EXAMPLE The relationship between the Possessed_characteristic "the health of James" and the Possessed_characteristic "the health of Frederick" indicating that the health of James is better than the health of Frederick, is a Possessed_characteristic_better.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_better
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.4 possessed_characteristic_equality

A Possessed_characteristic_equality is a Comparison_of_characteristic_with_reference where the magnitudes of the compared and referred are exactly the same.

EXAMPLE The relationship between the Possessed_characteristic "temperature of the temperature sensor" and the Possessed_characteristic "temperature of the fluid" that indicates the two temperatures are the same for a period of time, is a Possessed_characteristic_equality.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_equality
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.5 possessed_characteristic_greater_than

A Possessed_characteristic_greater_than is a Comparison_of_characteristic_with_reference where the magnitude of the compared exceeds that of the referred.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "shipping weight of the pump" indicating the vessel weight is more than the pump weight is a Possessed_characteristic_greater_than.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_greater_than
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.6 possessed_characteristic_greater_than_or_equal_to

A Possessed_characteristic_greater_than_or_equal_to is a Comparison_of_characteristic_with_reference where the magnitude of the compared exceeds or is equal to that of the referred.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "shipping weight of the pump" indicating the vessel weight is equal to or more than the pump weight is a Possessed_characteristic_greater_than_or_equal_to

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_greater_than_or_equal_to
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.7 possessed_characteristic_inside

A Possessed_characteristic_inside is a Comparison_of_characteristic_with_reference that indicates the compared characteristic is within the referred characteristic.

EXAMPLE 1 The relationship between the Possessed_characteristic "location of the pump" and the Possessed_characteristic "Plant area" indicating the location is within the plant area, is a Possessed_characteristic_inside.

EXAMPLE 2 The relationship between the Possessed_characteristic "temperature range 1" and the Possessed_characteristic "temperature range 2" indicating range 1 is within range 2, is a Possessed_characteristic_inside.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_inside
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.8 possessed_characteristic_less_than

A Possessed_characteristic_less_than is a Comparison_of_characteristic_with_reference where the magnitude of the compared is less than that of the referred.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "shipping weight of the pump" indicating the vessel weight is less than the pump weight is a Possessed_characteristic_less_than.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_less_than
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.9 possessed_characteristic_less_than_or_equal_to

A Possessed_characteristic_less_than_or_equal_to is a Comparison_of_characteristic_with_reference where the magnitude of the compared is less or equal to that of the referred.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "shipping weight of the pump" indicating the vessel weight is the same or less than the pump weight is a Possessed_characteristic_less_than_or_equal_to.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_less_than_or_equal_to
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.10 possessed_characteristic_not_equal

A Possessed_characteristic_not_equal is a Comparison_of_characteristic_with_reference where the magnitude of the compared is not equal to that of the referred.

EXAMPLE The relationship between the Possessed_characteristic "shipping weight of the vessel" and the Possessed_characteristic "installed weight of the vessel" indicating the shipping weight is not equal to the installed weight is a Possessed_characteristic_not_equal.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_not_equal
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.11 possessed_characteristic_outside

A Possessed_characteristic_outside is a Comparison_of_characteristic_with_reference that indicates the compared characteristic is outside the referred characteristic.

EXAMPLE The relationship between the Possessed_characteristic "location of the pump" and the Possessed_characteristic "Plant hazardous area" indicating the location is outside the hazardous plant area, is a Possessed_characteristic_outside.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_outside
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.12 possessed_characteristic_overlap

A possessed_characteristic_overlap is a Comparison_of_characteristic_with_reference that indicates the compared and the referred characteristics overlap.

EXAMPLE 1 The relationship between the Possessed_characteristic "period of time of meeting A" and the Possessed_characteristic "period of time of meeting B" that indicates the period of A overlaps the period of B, is an possessed_characteristic_overlap.

EXAMPLE 2 The relationship between the Possessed_characteristic "interference envelop of electrical instrument A" and the Possessed_characteristic "interference envelop of electrical instrument B" indicating they overlap in space, is a possessed_characteristic_overlap.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_overlap
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

7.14.13 possessed_characteristic_worse

A Possessed_characteristic_worse is a Comparison_of_characteristic_with_reference that indicates the compared characteristic is worse than the referred characteristic. Worse is a qualitative judgement made with no measurable criteria.

EXAMPLE The relationship between the Possessed_characteristic "the health of James" and the Possessed_characteristic "the health of Frederick" indicating that the health of James is worse than the health of Frederick, is a Possessed_characteristic_worse.

EXPRESS specification:

```
*)
ENTITY possessed_characteristic_worse
   SUBTYPE OF (comparison_of_characteristic_with_reference);
END_ENTITY;
(*
```

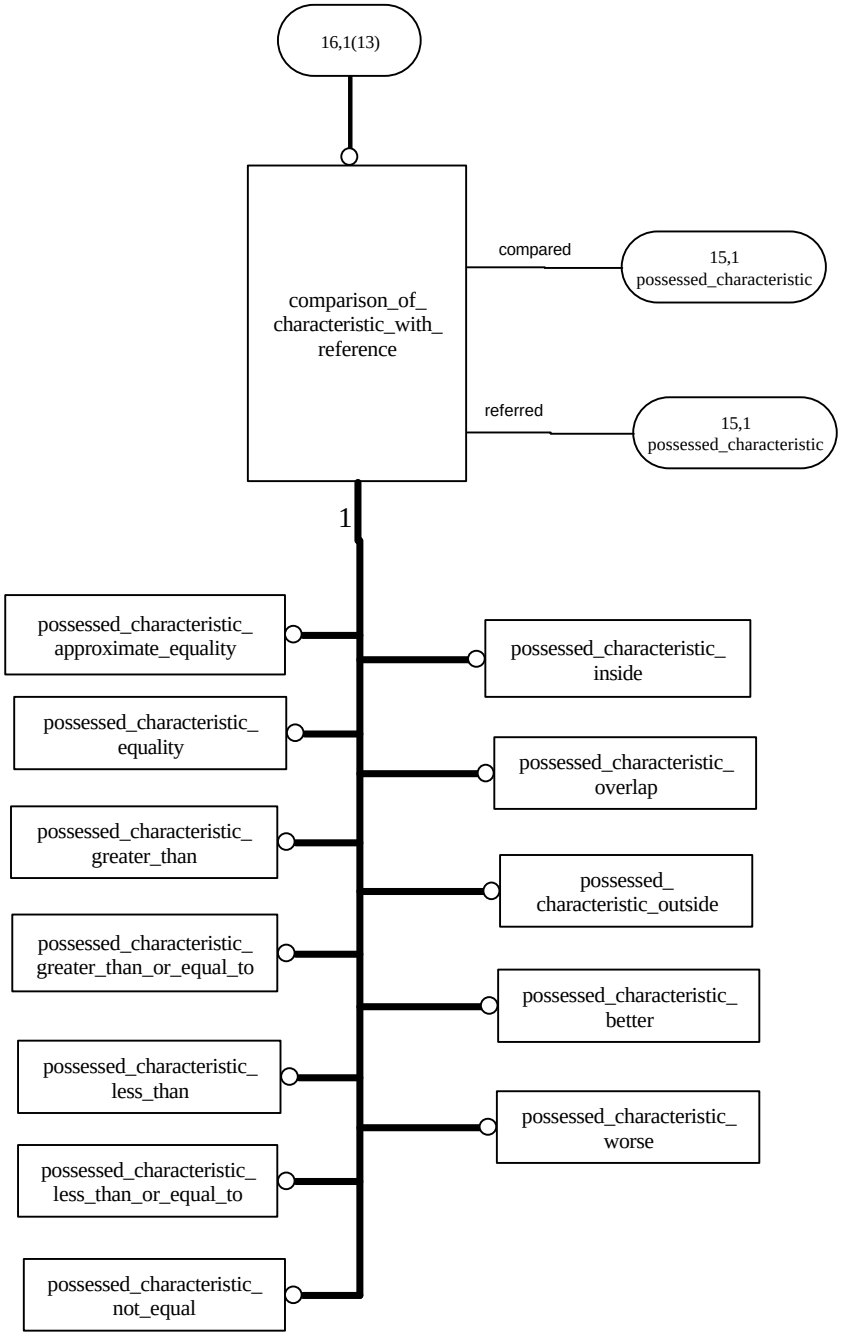


Figure 16 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Characteristic comparison

7.15 Class of characteristic

A description of the uses of the entity types shown in this section will go here, eventually.

7.15.1 class_of_characteristic

A Class_of_characteristic is a Class_of_individual that indicates a common nature of members of Possessed_characteristic.

EXPRESS specification:

```
*)
ENTITY class_of_characteristic
      ABSTRACT SUPERTYPE OF (ONEOF (concept_of_characteristic,
                                    qualified_characteristic,
                                    common_characteristic)
                           ANDOR ONEOF (class_of_property,
                                    class_of_temporal_aspect,
                                    class_of_spatial_aspect,
                                    class_of_count,
                                    class_of_quality))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.15.2 common_characteristic

A common_characteristic is a Class_of_characteristic and a Common_aspect that is a specialization of Possessed_characteristic that indicates the magnitude of Possessed_characteristics.

A Common_characteristic is a specialisation of an appropriate Concept_of_characteristic.

EXAMPLE 1 The pressure of 15 bar gauge is a 15 bar gauge pressure Common_characteristic.

EXAMPLE 2 The diameter of the circle 20 cms is a 20 cms length common characteristic.

EXAMPLE 3 Times of 1530 GMT 25 April 1998 is a common characteristic.

EXAMPLE 4 Pressure greater than 15 bar gauge is a common characteristic.

EXPRESS specification:

```
*)
ENTITY common_characteristic
   SUPERTYPE OF (ONEOF (common_property,
                        common_spatial_aspect,
                        common_temporal_aspect,
                        common_count,
                        common_quality))
   SUBTYPE OF (class_of_characteristic,
               common_aspect);
END_ENTITY;
(*
```

7.15.3 common_characteristic_approximate_equality

A Common_characteristic_approximate_equality is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_approximate_equality constraining the members of the compared class to be similar to members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_approximate_equality
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.4 common_characteristic_equality

A Common_characteristic_equality is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_equality constraining the members of the compared class to be equal to members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_equality
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.5 common_characteristic_greater_or_equal

A Common_characteristic_greater_or_equal is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_greater_than_or_equal_to constraining the members of the compared class to be greater than or equal to members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_greater_or_equal
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.6 common_characteristic_greater_than

A Common_characteristic_greater_than is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_greater_than constraining the members of the compared class to be greater than members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_greater_than
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.7 common_characteristic_inside

A Common_characteristic_inside is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_inside constraining the members of the compared class to be within members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_inside
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.8 common_characteristic_less

A Common_characteristic_less is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_less_than constraining the members of the compared class to be less than to members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_less
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.9 common_characteristic_less_or_equal

A Common_characteristic_less_or_equal is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_less_than_or_equal_to constraining the members of the compared class to be less than or equal to members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_less_or_equal
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.10 common_characteristic_outside

A Common_characteristic_outside is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_outside constraining the members of the compared class to be outside members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_outside
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.11 common_characteristic_overlap

A Common_characteristic_overlap is a Comparison_of_common_characteristic_with_reference that is a specialization of Possessed_characteristic_overlap constraining the members of the compared class to overlap members of the referred class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_characteristic_overlap
   SUBTYPE OF (comparison_of_common_characteristic_with_reference);
END_ENTITY;
(*
```

7.15.12 common_composition_of_characteristic

A Common_composition_of_characteristic is a Common_association that is a specialization of Composition_of_possessed_characteristic that constrains members of the whole class to have parts that are members of the part class.

EXAMPLE The class of relationship between the class_of_characteristic "Qh" and the Class_of_characteristic "Q" and "h" that indicates a Qh possessed_characteristic has a Q and an h component is a Common_composition_of_charcateristic. The allowed cardinality restricts the Qh characteristic to have one Q and one h, both simultaneously and throughout its life.

EXPRESS specification:

```
*)
ENTITY common_composition_of_characteristic
   SUBTYPE OF (common_association);
   part  : LIST [1:?] OF common_characteristic;
   whole : common_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the LIST of Class_of_characteristic whose members are parts of the whole.

The part role corresponds to role_1 of the common_association cardinality data.

whole: The whole specifies the Class_of_characteristic whose members are the whole for members of the part class.

The whole role corresponds to role_2 in the common_association cardinality data.

7.15.13 common_derivation_of_characteristic

A Common_derivation_of_characteristic is a Common_association that is a specialization of Derivation_of_possessed_characteristic that constrains members of the derivative class to be dependent on members of the LIST of source classes.

EXAMPLE The relationship between the Class_of_characteristic "flow velocity" and the two characteristic classes "volumetric flow rate" and "flow area" indicating that a flow velocity may be dependent on a volumetric flow rate and a flow area is a Common_derivation_of_characteristic.

EXPRESS specification:

```
*)
ENTITY common_derivation_of_characteristic
   SUBTYPE OF (common_association);
   derivative : common_characteristic;
   source     : LIST [1:?] OF common_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

derivative: The derivative specifies the class_of_characteristic whose members may depend on members of the source LIST of class_of_characteristic.

The derivative role corresponds to role_1 in the Common_association cardinality data.

source: The source specifies a LIST of class_of_characteristic whose members the derived class_of_characteristic members depend upon.

The source role corresponds to role_2 in the Common_association cardinality data.

7.15.14 comparison_of_common_characteristic_with_reference

A Comparison_of_common_characteristic_with_reference is a Common_association that is a specialization of Comparison_of_characteristic_with_reference that constrains members of the compared class to be compared with members of the referenced class.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY comparison_of_common_characteristic_with_reference
   SUPERTYPE OF (ONEOF (common_characteristic_inside,
                        common_characteristic_outside,
                        common_characteristic_overlap,
                        common_characteristic_approximate_equality,
                        common_characteristic_equality,
                        common_characteristic_greater_than,
                        common_characteristic_greater_or_equal,
                        common_characteristic_less,
                        common_characteristic_less_or_equal))
   SUBTYPE OF (common_association);
   compared : common_characteristic;
   referred : common_characteristic;
END_ENTITY;
(*
```

Attribute definitions:

compared: The compared specifies the Common_characteristic whose members are compared to the members of the referenced Common_characteristic.

The compared role corresponds to role_1 of the Common_association cardinality data

referred: The referred specifies the Common_characteristic whose members are referenced by members of the compared class.

The referred role corresponds to role_2 of the Common_association cardinality data.

7.15.15 concept_of_characteristic

A Concept_of_characteristic is a Class_of_characteristic and a Class_of_concept that is a physical phenomena or quality common nature of Possessed_characteristic.

EXAMPLE 1 Pressure is a Concept_of_characteristic.

EXAMPLE 2 Shape is a Concept_of_characteristic.

EXAMPLE 3 Lifetime is a Concept_of_characteristic

EXPRESS specification:

```
*)
ENTITY concept_of_characteristic
   SUPERTYPE OF (ONEOF (concept_of_property,
                        concept_of_spatial_aspect,
                        concept_of_temporal_aspect,
                        concept_of_count,
                        concept_of_quality))
   SUBTYPE OF (class_of_characteristic,
               concept_of_aspect);
END_ENTITY;
(*
```

7.15.16 qualified_characteristic

A Qualified_characteristic is a Class_of_characteristic and a Qualified_aspect that combines a concept class with a qualification and a constraint on its magnitude. The concept defines a physical phenomenom and the qualification the circumstances of its use.

The concept, qualification and magnitude are defined by specialization relationships to Concept_of_characteristic, Common_characteristic and Qualified_aspect

EXAMPLE A design operating pressure of 15 bar g is a Qualified_characteristic that is a specialization of: the Concept_of_characteristic "pressure"; the Common_characteristic "15 bar g"; and the Qualified_aspect "design operating".

EXPRESS specification:

```
*)
ENTITY qualified_characteristic
   SUPERTYPE OF (ONEOF (qualified_property,
                        qualified_spatial_aspect,
                        qualified_temporal_aspect,
                        qualified_count,
                        qualified_quality))
   SUBTYPE OF (class_of_characteristic,
                qualified_aspect);
END_ENTITY;
(*
```

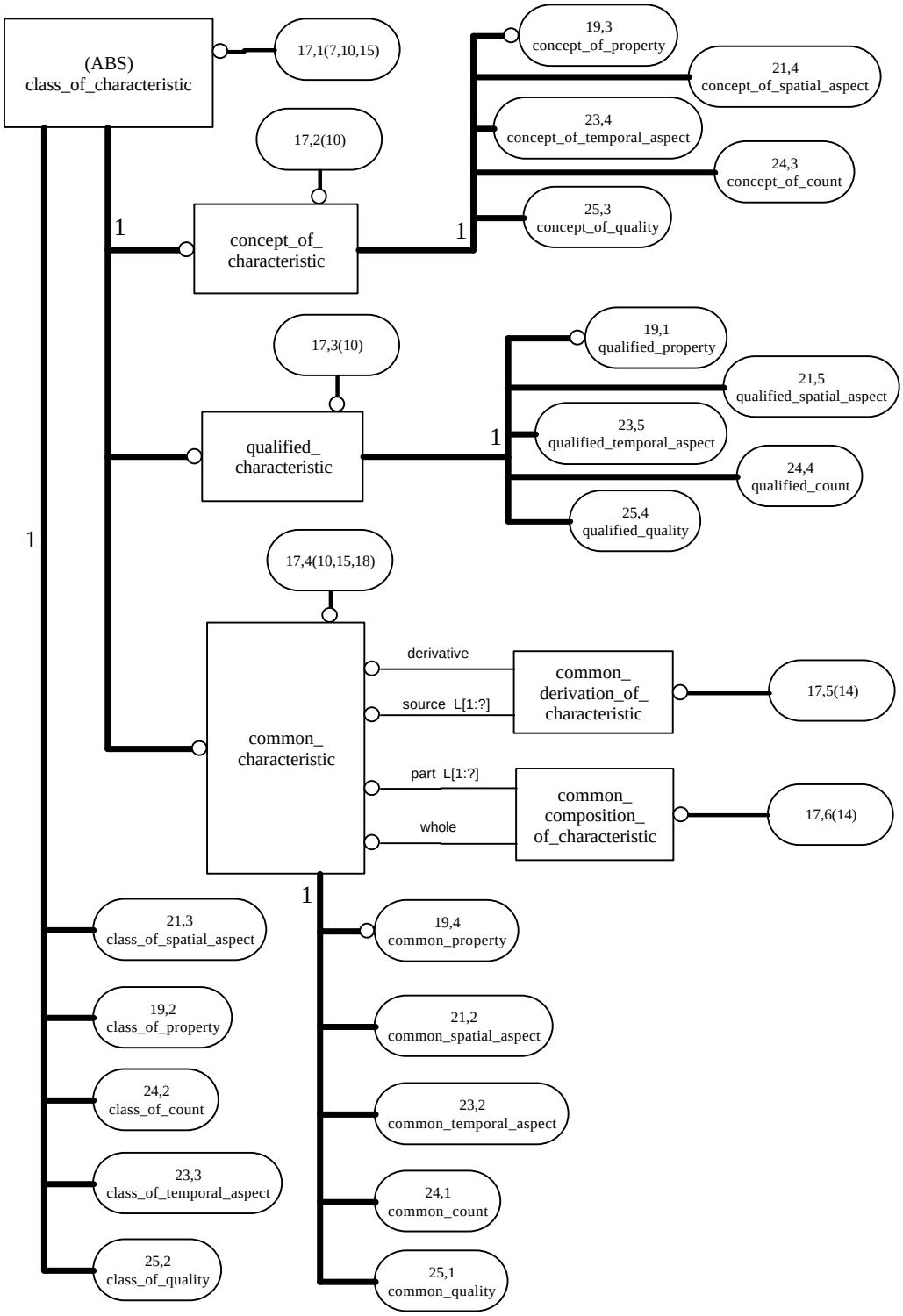


Figure 17 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of characteristic (1 of 2)

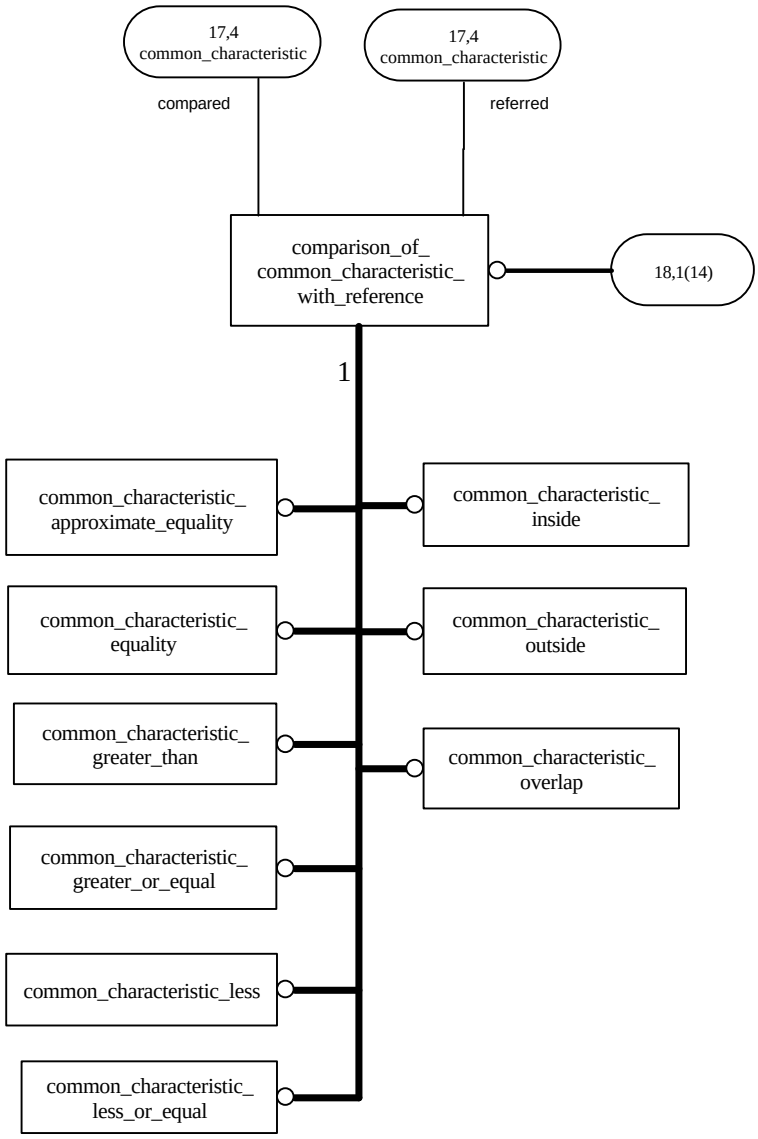


Figure 18 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of characteristic (2 of 2)

7.16 Class of property

A description of the uses of the entity types shown in this section will go here, eventually.

7.16.1 class_of_property

A Class_of_property is a Class_of_characteristic that indicates a common nature of some members of possessed_property.

EXAMPLE 1 The Concept_of_property "temperature" is a Class_of_property.

EXAMPLE 2 The Common_property "temperature of 20 deg C" is a Class_of_property.

EXPRESS specification:

```
*)
ENTITY class_of_property
   ABSTRACT SUPERTYPE OF (ONEOF (qualified_property,
                                 concept_of_property,
                                 common_property))
   SUBTYPE OF (class_of_characteristic);
END_ENTITY;
(*
```

7.16.2 class_of_scale

A Class_of_scale is a Class_of_association that indicates a common nature of measurement scales.

EXAMPLE 1 Linear is a Class_of_scale and a Concept_of_scale.

EXAMPLE 2 Centigrade is a Class_of_scale and a Common_scale for measuring temperature properties.

EXPRESS specification:

```
*)
ENTITY class_of_scale
      ABSTRACT SUPERTYPE OF (ONEOF (common_scale,
                                    concept_of_scale))
   SUBTYPE OF (class_of_association);
END_ENTITY;
(*
```

7.16.3 common_encoded_scale_valuation

A Common_encoded_scale_valuation is a Common_association that indicates members of the specified property class all have the same scale value, defined by a number and the scale type.

EXAMPLE The class of relationship between the Common_property "Pressure of 15 Barg" and the Encoded_numeric_object "15", and that is a specialisation of the Common_scale "Bar gauged", is a Common_encoded_scale_valuation.

EXPRESS specification:

```
*)
ENTITY common_encoded_scale_valuation
   SUBTYPE OF (common_association);
   encoded_number : encoded_numeric_object;
   property       : common_property;
END_ENTITY;
(*
```

Attribute definitions:

encoded_number: The encoded_number is the Encoded_numeric_object that identifies the number of the scale.

The encoded_number role corresponds to role_1 of the Common_association cardinality data.

property: The property specifies the Common_property members that correspond to the mathematics value on the scale.

The property role corresponds to role_2 of the Common_association cardinality data.

7.16.4 common_point_property

A Common_point_property is a Common_property that allows no variation i.e. no degrees of freedom, completely defined.

EXAMPLE The pressure of 15 bar gauge is a Common_point_property.

EXPRESS specification:

```
*)
ENTITY common_point_property
   SUBTYPE OF (common_property);
END_ENTITY;
(*
```

7.16.5 common_property

A Common_property is a Class_of_property and a Common_characteristic that indicates the magnitude of the possessed_property members. The magnitude of the members is described using a Common_scale and a number.

EXAMPLE The pressure of 15 bar gauge is a common property. This common_property is a specialization of the Concept_of_property class "pressure" and has a Common_encoded_scale_valuation to the number "15" on the Common_scale "Bar gauge".

EXPRESS specification:

```
*)
ENTITY common_property
   SUPERTYPE OF (ONEOF (common_property_space,
                        common_point_property))
   SUBTYPE OF (class_of_property, common_characteristic);
END_ENTITY;
(*
```

7.16.6 common_property_space

A Common_property_space is a Common_property that allows variation.

EXAMPLE 1 The pressure range of 15 to 16 bar gauge is a Common_property_space.

EXAMPLE 2 The Qh value pair, where both Q and h are fixed is not a Common_property_space, whereas the Qh pair where Q is dependent to h is a Common_property_space with one degree of freedom.

EXAMPLE 3 The range of pressures between 0 and 100 psi is a Common_property_space.

EXPRESS specification:

```
*)
ENTITY common_property_space
   SUBTYPE OF (common_property);
END_ENTITY;
(*
```

7.16.7 common_scale

A Common_scale is a Common_association that defines a type of scale that members of the Concept_of_property may be measured on. Members of Common_scale are relationships between members of Concept_of_property and members of the Concept_of_mathematical_object.

EXAMPLE The class of relationship between the Concept_of_property "temperature" and the Common_mathematical_object "all real numbers" that indicates a temperature is mapped to a real number in the way defined by Centigrade is the "centigrade" Common_scale.

EXPRESS specification:

```
*)
ENTITY common_scale
   SUBTYPE OF (class_of_scale,
               common_association);
   mathematics : concept_of_mathematical_object;
   property    : concept_of_property;
END_ENTITY;
(*
```

Attribute definitions:

mathematics: The mathematics specifies the concept_of_mathematical_object class whose members define the magnitude of a property.

The mathematics role corresponds to role_1 of the Common_association cardinality data,

property: The property specifies the Concept_of_property class whose members can be evaluated using the Common_scale.

The property role corresponds to role_2 of the Common_association cardinality data.

7.16.8 common_scale_valuation

A Common_scale_valuation is a Common_association that is a specialization of a Common_scale that constrains the members of the property class to have magnitudes described by the number and scale.

EXAMPLE The class of relationship between the Common_property "temperature of 20 deg C" and the Common_mathematical_object "20" that is a specialization of Common_scale "Centigrade" is a Common_scale_valuation.

Note the same Common_property can also have a Common_scale_valuation that is a specialization of the Common_scale "Fahrenheit" with the number "68".

EXPRESS specification:

```
*)
ENTITY common_scale_valuation
   SUBTYPE OF (common_association);
   mathematics : common_mathematical_object;
   property    : common_property;
END_ENTITY;
(*
```

Attribute definitions:

mathematics: The mathematics is the Common_mathematical_object that is the values of the scale valuation.

The mathematics role corresponds to role_1 of the Common_association cardinality data.

property: The property is the Common_property whose magnitude is recorded by the scale valuation.

The property role corresponds to role_2 of the Common_association cardinality data.

7.16.9 concept_of_property

A Concept_of_property is a Class_of_property and a Concept_of_characteristic that indicates a common generic nature of possessed physical phenomenon.

EXAMPLE Pressure is a Concept_of_property.

EXPRESS specification:

```
*)
ENTITY concept_of_property
   SUBTYPE OF (class_of_property,
               concept_of_characteristic);
END_ENTITY;
(*
```

7.16.10 concept_of_scale

A Concept_of_scale is a Class_of_scale and a Concept_of_association that indicates a generic common nature of scales.

EXAMPLE A ratio scale, a scale with a lower limit of zero and a constant devision of one, is a Concept_of_scale. The kilogramme scale is a ratio scale.

EXPRESS specification:

```
*)
ENTITY concept_of_scale
   SUBTYPE OF (class_of_scale,
               concept_of_association);
END_ENTITY;
(*
```

7.16.11 qualified_property

A Qualified_property is a Class_of_property and a Qualified_characteristic defining the context or circumstances and magnitude a of possessed property characteristic.

EXAMPLE A maximum operating pressure of 15 Bar gauge is a Qualified_property. The Qualified_property has a Specialization_of_class relationship to the Common_property "pressure of 15 bar gauge" and with the Aspect_qualifier "maximum operating".

EXPRESS specification:

```
*)
ENTITY qualified_property
   SUBTYPE OF (class_of_property,
               qualified_characteristic);
END_ENTITY;
(*
```

7.16.12 unit_of_measure

A Unit_of_measure is a Common_point_property that has a common_scale_valuation of the number one.

EXAMPLE: the Common_point_property that maps to 1 on the Kilogramme scale is a Unit_of_measure. Note that the same Common_point_property may also have valuations on other scales such as a value of 2.24 on the pound scale.

EXPRESS specification:

```
*)
ENTITY unit_of_measure
   SUBTYPE OF (common_point_property);
END_ENTITY;
(*
```

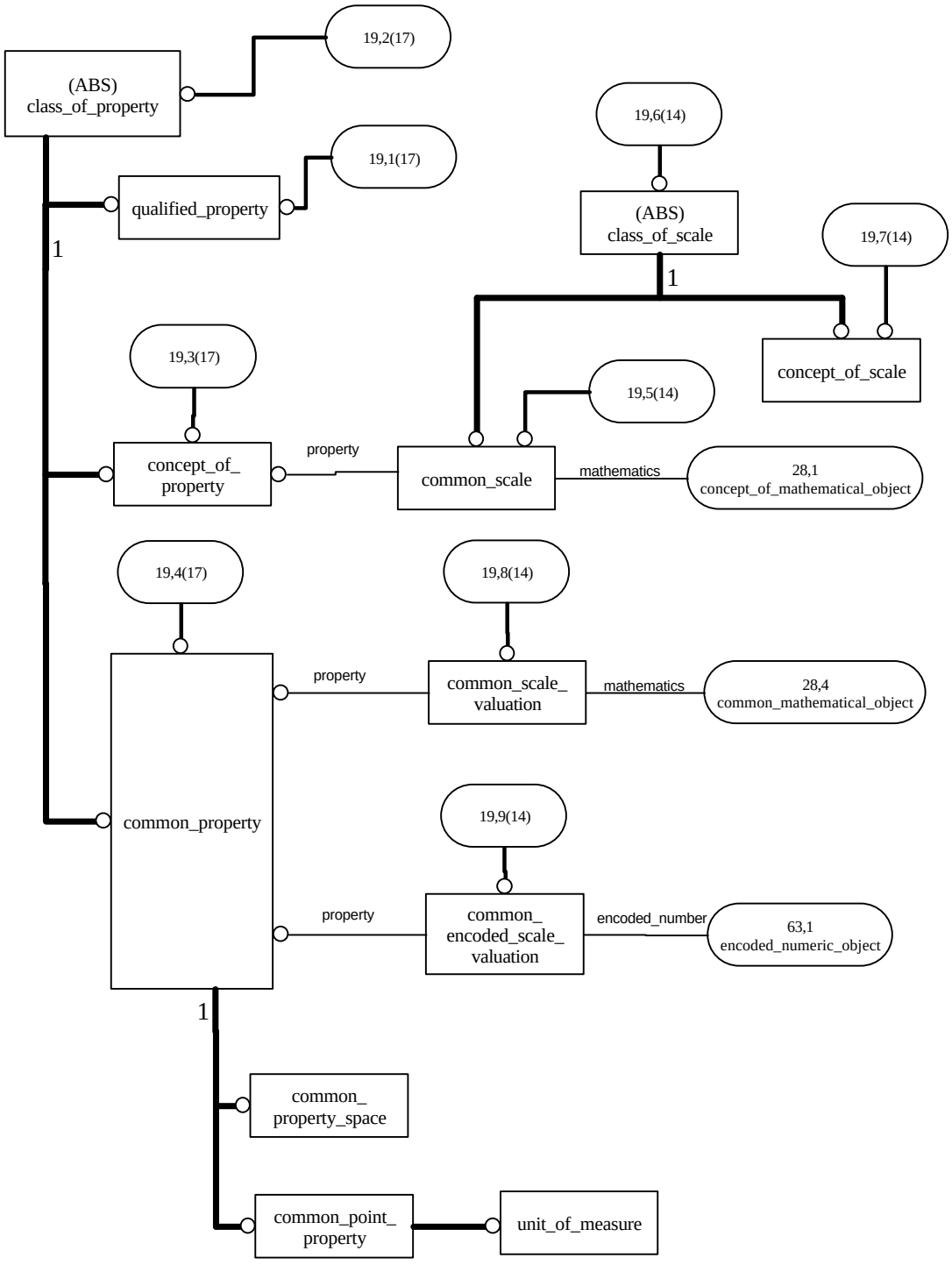


Figure 19 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of property

7.17 Possessed spatial aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.17.1 bounding_of_curve_by_point_in_space

A Bounding_of_curve_by_point_in_space is a Bounding_of_possessed_spatial_aspect that indicates the bounding point is the start or end of the curve.

EXAMPLE The relationship between the Possessed_point_in_space A and the Possessed_curve_in_space X indicating that A is an end point of X is a Bounding_of_curve_by_point_in_space.

EXPRESS specification:

```
*)
ENTITY bounding_of_curve_by_point_in_space
   SUBTYPE OF (bounding_of_possessed_spatial_aspect);
   SELF\bounding_of_possessed_spatial_aspect.bounded  : possessed_curve_in_space;
   SELF\bounding_of_possessed_spatial_aspect.bounding : possessed_point_in_space;
END_ENTITY;
(*
```

Attribute definitions:

bounded: The bounded specifies the Possessed_curve_in_space whose extent is limited by the bounding Possessed_point_in_space.

bounding: The bounding specifies the Possessed_point_in_space that is a bound for the bounded Possessed_curve_in_space.

7.17.2 bounding_of_possessed_spatial_aspect

A Bounding_of_possessed_spatial_aspect is Possessed_association that indicates that the spatial extent of the bounded Possessed_spatial_aspect is limited by the bounding Possessed_spatial_aspect.

EXPRESS specification:

```
*)
ENTITY bounding_of_possessed_spatial_aspect
   SUPERTYPE OF (ONEOF (bounding_of_curve_by_point_in_space,
                        bounding_of_surface_by_curve_in_space,
                        bounding_of_volume_by_surface_in_space))
   SUBTYPE OF (possessed_association);
   bounded  : possessed_spatial_aspect;
   bounding : possessed_spatial_aspect;
END_ENTITY;
(*
```

Attribute definitions:

bounded: The bounded specifies the Possessed_spatial_aspect whose extent is limited by the bounding Possessed_spatial_aspect.

bounding: The bounding specifies the Possessed_spatial_aspect that limits the extent of the bounded Possessed_spatial_aspect.

7.17.3 bounding_of_surface_by_curve_in_space

A Bounding_of_surface_by_curve_in_space is a Bounding_of_possessed_spatial_aspect that indicates the bounding curve defines a boundary of the bounded surface.

EXAMPLE The relationship between the Possessed_curve_in_space "North border" and the Possessed_surface_in_space "Home Farm area" indicating that the North border is a boundary of the Home Farm is a Bounding_of_surface_by_curve_in_space.

EXPRESS specification:

```
*)
ENTITY bounding_of_surface_by_curve_in_space
   SUBTYPE OF (bounding_of_possessed_spatial_aspect);
   SELF\bounding_of_possessed_spatial_aspect.bounded  : possessed_surface_in_space;
   SELF\bounding_of_possessed_spatial_aspect.bounding : possessed_curve_in_space;
END_ENTITY;
(*
```

Attribute definitions:

bounded: The bounded specifies the Possessed_surface_in_space whose extent is limited by the bounding Possessed_curve_in_space.

bounding: The bounding specifies the Possessed_curve_in_space that is a bound for the bounded Possessed_surface_in_space.

7.17.4 bounding_of_volume_by_surface_in_space

A bounding_of_volume_by_surface_in_space is a Bounding_of_possessed_spatial_aspect that indicates the bounding surface is a boundary of the bounded Possessed_volume_in_space.

EXAMPLE The relationship between the Possessed_surface_in_space "Earth surface" and the Possessed_volume_in_space "Earth volume" indicating that the Earth's surface is a boundary of the Earth's volume is a Bounding_of_volume_by_surface_in_space. Note the surface is regarded as a part of the volume.

EXPRESS specification:

```
*)
ENTITY bounding_of_volume_by_surface_in_space
   SUBTYPE OF (bounding_of_possessed_spatial_aspect);
   SELF\bounding_of_possessed_spatial_aspect.bounded  : possessed_volume_in_space;
   SELF\bounding_of_possessed_spatial_aspect.bounding : possessed_surface_in_space;
END_ENTITY;
(*
```

7.17.5 description_of_possessed_spatial_aspect

A Description_of_possessed_spatial_aspect is a Description_of_object_by_encoded_information that indicates the described Possessed_spatial_aspect is described by the describer encoded_placement.

EXPRESS specification:

```
*)
ENTITY description_of_possessed_spatial_aspect
   SUBTYPE OF (description_of_object_by_encoded_information);
   SELF\description_of_object_by_encoded_information.described :
      possessed_spatial_aspect;
   SELF\description_of_object_by_encoded_information.describer : encoded_placement;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Possessed_spatial_aspect that is the described by the Encoded_placement.

describer: The describer specifies the Encoded_placement that describes the Possessed_spatial_aspect.

7.17.6 possessed_curve_in_space

A Possessed_curve_in_space is a Possessed_spatial_aspect that is the occupation or use of a curve in space.

A Possessed_curve_in_space has a topological dimension of 1 (1 degree of freedom). Each point within a Possessed_curve_in_space can be uniquely identified by a real number.

EXAMPLE The centre line of this pipe is a Possessed_curve_in_space.

EXPRESS specification:

```
*)
ENTITY possessed_curve_in_space
   SUBTYPE OF (possessed_spatial_aspect);
END_ENTITY;
(*
```

7.17.7 possessed_point_in_space

A Possessed_point_in_space is a Possessed_spatial_aspect that is the occupation or use of a single point in space.

A Possessed_point_in_space has a topological dimension of O (O degrees of freedom).

EXAMPLE 1 The datum point P-1 of my vessel that enables it to be positioned on a foundation is a Possessed_point_in_space.

EXAMPLE 2 The centre of gravity of my vessel is a Possessed_point_in_space.

EXPRESS specification:

```
*)
ENTITY possessed_point_in_space
   SUBTYPE OF (possessed_spatial_aspect);
END_ENTITY;
(*
```

7.17.8 possessed_shape

A Possessed_shape is a Possessed_spatial_aspect that is the change of occupation or use of space with respect to a change in position. Shape is a possessed_aspect of a possessed_spatial_aspect.

Note this definition is incomplete and needs more work.

EXAMPLE 1 The Possessed_shape of a curve is straight.

EXAMPLE 2 The Possessed_shape of a spherical volume is a sphere.

EXPRESS specification:

```
*)
ENTITY possessed_shape
   SUBTYPE OF (possessed_spatial_aspect);
END_ENTITY;
(*
```

7.17.9 possessed_spatial_aspect

A Possessed_spatial_aspect is a Possessed_characteristic that is an occupation or use of space.

EXAMPLE 1 The volume occupied by a pipeline is a Possessed_spatial_aspect.

EXAMPLE 2 The centre line of a pipe is a possessed spatial aspect.

EXPRESS specification:

```
*)
ENTITY possessed_spatial_aspect
   SUPERTYPE OF (possessed_shape
           ANDOR ONEOF (possessed_point_in_space,
                        possessed_curve_in_space,
                        possessed_surface_in_space,
                        possessed_volume_in_space))
   SUBTYPE OF (possessed_characteristic);
   event_possessor    : possessed_event_effect;
   relative_possessor : relative_placement_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

event_possessor: The event_possessor specifies the Possessed_event_effect that is the possessor of the Possessed_spatial_aspect.

Note there is a specialization problem here. Possessed_spatial_aspect inherits the possessor attribute enabling it to be possessed by many types of individual. This cannot be specialised. So a new attribute name is given.

relative_possessor: The relative_possessor specifies the relative_placement_of_physical_object that possesses the Possessed_spatial aspect.

Note this was a specialization of the inherited possessor attribute that restricted spatial aspects to relatives of physical object.

7.17.10 possessed_surface_in_space

A Possessed_surface_in_space is a Possessed_spatial_aspect that is the occupation or use of a surface in space.

A Possessed_surface_in_space has a topological dimension of 2 (2 degrees of freedom). Each point within a Possessed_surface_in_space can be uniquely identified by a pair of real numbers.

EXAMPLE The flange surface of the inlet nozzle of vessel V-4506 is a Possessed_surface_in_space.

EXPRESS specification:

```
*)
ENTITY possessed_surface_in_space
   SUBTYPE OF (possessed_spatial_aspect);
END_ENTITY;
(*
```

7.17.11 possessed_volume_in_space

A Possessed_volume_in_space is a Possessed_spatial_aspect that is the occupation or use of a volume in space.

A Possessed_volume_in_space has a topological dimension of 3 (3 degrees of freedom). Each point within a Possessed_volume_in_space can be uniquely identified by a triplet of real numbers.

EXAMPLE The occupied space of the solid matter of the vessel V-4506 is a Possessed_volume_in_space.

EXPRESS specification:

```
*)
ENTITY possessed_volume_in_space
   SUBTYPE OF (possessed_spatial_aspect);
END_ENTITY;
(*
```

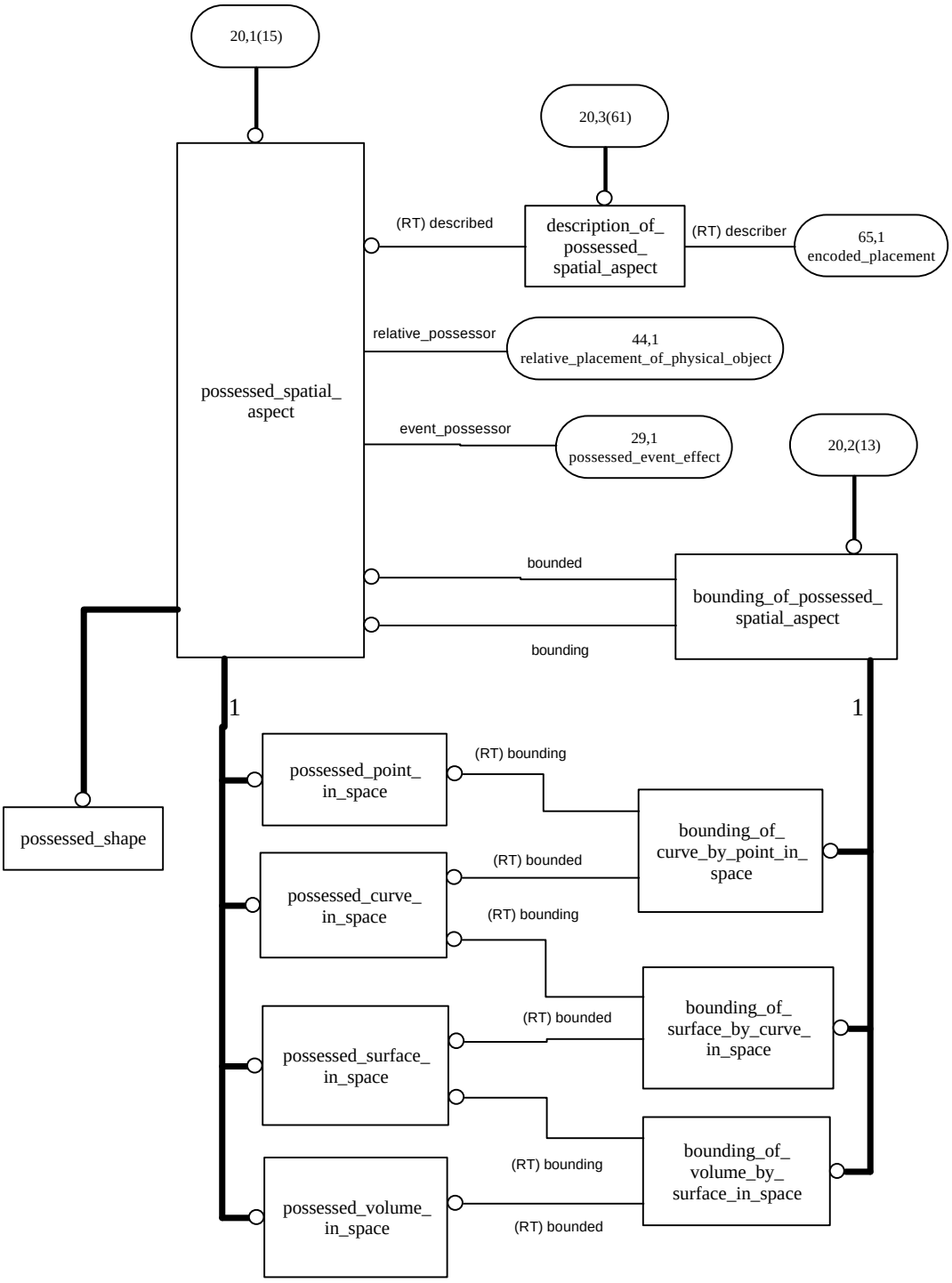


Figure 20 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed spatial aspect

7.18 Class of spatial aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.18.1 class_of_spatial_aspect

A Class_of_spatial_aspect is a Class_of_characteristic that indicates a common nature of Possessed_spatial_aspect.

EXPRESS specification:

```
*)
ENTITY class_of_spatial_aspect
   ABSTRACT SUPERTYPE OF (ONEOF (concept_of_spatial_aspect,
                                 qualified_spatial_aspect,
                                 common_spatial_aspect))
   SUBTYPE OF (class_of_characteristic);
END_ENTITY;
(*
```

7.18.2 common_shape

A Common_shape is a Common_spatial_aspect that indicates the magnitude of the Possessed_shape members.

EXAMPLE 1 A straight line of slope 1.0 is a Common_shape.

EXAMPLE 2 A constant radius of length 10 is a Common_shape.

EXPRESS specification:

```
*)
ENTITY common_shape
   SUBTYPE OF (common_spatial_aspect);
END_ENTITY;
(*
```

7.18.3 common_spatial_aspect

A Common_spatial_aspect is a Class_of_spatial_aspect and a Common_characteristic that is finite or infinite set of points in space that remain unchanged with respect to a spatial frame.

EXPRESS specification:

```
*)
ENTITY common_spatial_aspect
   SUPERTYPE OF (ONEOF (common_spatial_frame,
                        common_shape))
   SUBTYPE OF (class_of_spatial_aspect, common_characteristic);
END_ENTITY;
(*
```

7.18.4 common_spatial_frame

This is deliberately blank.

EXPRESS specification:

```
*)
ENTITY common_spatial_frame
   SUBTYPE OF (common_spatial_aspect);
END_ENTITY;
(*
```

7.18.5 concept_of_shape

A Concept_of_shape is a Concept_of_spatial_aspect that is the relative positions of a finite or infinite set of points in space.

A Concept_of_shape does not have a particular position and orientation with respect a spatial frame.

EXAMPLE 1 Cubic is a Concept_of_shape.

EXAMPLE 2 Flat is a Concept_of_shape.

EXPRESS specification:

```
*)
ENTITY concept_of_shape
   SUBTYPE OF (concept_of_spatial_aspect);
END_ENTITY;
(*
```

7.18.6 concept_of_spatial_aspect

A Concept_of_spatial_aspect is a Class_of_spatial_aspect and a Concept_of_characteristic that indicates a generic nature of members of Possessed_spatial_aspect.

EXAMPLE 1 Surface is a Concept_of_spatial_aspect.

EXPRESS specification:

```
*)
ENTITY concept_of_spatial_aspect
   SUPERTYPE OF (ONEOF (concept_of_spatial_frame,
                        concept_of_shape))
   SUBTYPE OF (class_of_spatial_aspect,
               concept_of_characteristic);
END_ENTITY;
(*
```

7.18.7 concept_of_spatial_frame

A Concept_of_spatial_frame is a Concept_of_spatial_aspect that indicates the spatial frame of the member instances of Possessed_spatial_aspect.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY concept_of_spatial_frame
   SUBTYPE OF (concept_of_spatial_aspect);
END_ENTITY;
(*
```

7.18.8 description_of_common_spatial_aspect

A Description_of_common_spatial_aspect is a Common_association that is a specialisation of Description_of_spatial_aspect that constrains members of the common_spatial_aspect class to be described by the Encoded_placement.

EXPRESS specification:

```
*)
ENTITY description_of_common_spatial_aspect
   SUBTYPE OF (common_association);
   described : common_spatial_aspect;
   describer : encoded_placement;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Common_spatial_aspect whose members are described by the describer Encoded_placement.

The described corresponds to Role_1 of the Common_association cardinality data.

describer: The describer specifies the Encoded_placement that describes the members of the described Common_spatial_aspect class.

The describer role corresponds to Role_2 of the Common_association cardinality data.

7.18.9 qualified_spatial_aspect

A Qualified_spatial_aspect is a Class_of_spatial_aspect and a Qualified_characteristic. A Qualified_spatial_aspect may be a specialization of:

a) Aspect_qualifier, to define its context or role.

b) Common_spatial_aspect, to define the extent and magnitude.

c) Concept_of_spatial_aspect, to define its generic nature.

EXAMPLE the sealing surface of a 210mm raised face flange is a Qualified_spatial_aspect that is a specialization of the Aspect_qualifier "sealing", of the Common_spatial_aspect "210mm dia raised face" and of the Concept_of_spatial_aspect "surface".

EXPRESS specification:

```
*)
ENTITY qualified_spatial_aspect
   SUBTYPE OF (class_of_spatial_aspect, qualified_characteristic);
END_ENTITY;
(*
```

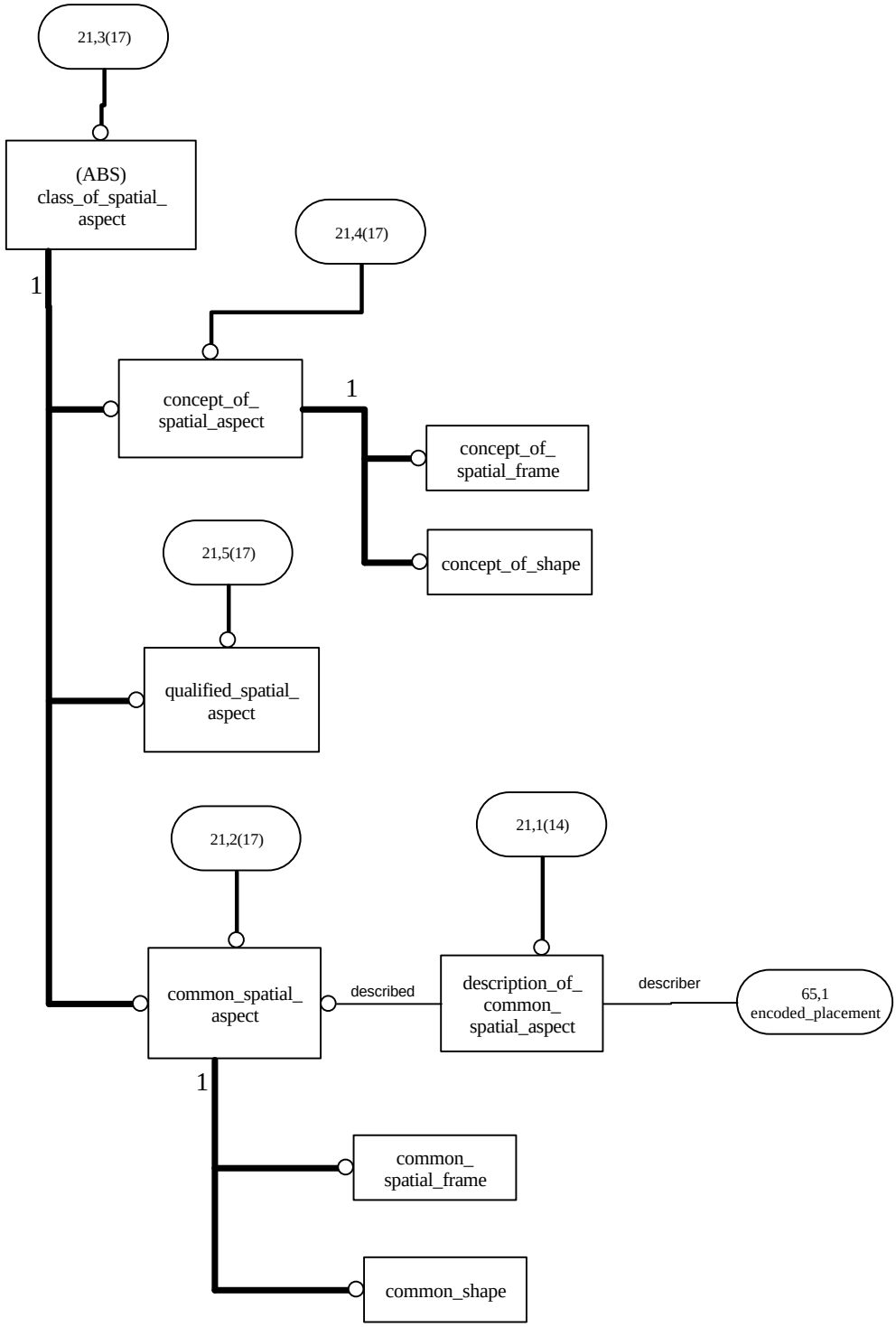


Figure 21 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of spatial aspect

7.19 Possessed temporal aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.19.1 description_of_possessed_point_in_time_by_encoded_date_and_time

A Description_of_possessed_point_in_time_by_encoded_date_and_time is a Description_of_object_by_encoded_information that indicates the describing Encoded_date_and_time is an identification of the Common_point_in_time that is occupied or used or classifies the described Possessed_point_in_time.

EXAMPLE The relationship between the opening time of the grocery store and the encoding 08:30 1998-11-02 (+1) is a Description_of_possessed_point_in_time_by_encoded_date_and_time.

EXPRESS specification:

```
*)
ENTITY description_of_possessed_point_in_time_by_encoded_date_and_time
   SUBTYPE OF (description_of_object_by_encoded_information);
   SELF\description_of_object_by_encoded_information.described :
      possessed_point_in_time;
   SELF\description_of_object_by_encoded_information.describer :
      encoded_date_and_time;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Possessed_point_in_time that is described by the describing Encoded_date_and_time.

describer: The describer specifies the Encoded_date_and_time the describes the Possessed_point_in_time.

7.19.2 end_point_in_time_of_possessed_period_of_time

An End_point_in_time_of_possessed_period_of_time is a Possessed_association that indicates the end_time Possessed_point_in_time terminates the period Possessed_period_of_time.

EXAMPLE The relationship between the 2nd operating period of the Vessel V-4506 and the end of the shift is an end_point_in_time_of_possessed_period_of_time.

EXPRESS specification:

```
*)
ENTITY end_point_in_time_of_possessed_period_of_time
   SUBTYPE OF (possessed_association);
   end_time : possessed_point_in_time;
   period   : possessed_period_in_time;
END_ENTITY;
(*
```

Attribute definitions:

end_time: The end_time specifies the Possessed_point_in_time that terminates the period Possessed_period_of_time.

period: The period specifies the Possessed_period_of_time that ends at the end_time Possessed_point_in_time.

7.19.3 possessed_period_in_time

A Possessed_period_of_time is a Possessed_temporal_aspect that is the occupation or use of a period or interval of time.

EXAMPLE The lifetime of Vessel V-4506 is a Possessed_period_of_time.

EXPRESS specification:

```
*)
ENTITY possessed_period_in_time
   SUBTYPE OF (possessed_temporal_aspect);
END_ENTITY;
(*
```

7.19.4 possessed_point_in_time

A Possessed_point_in_time is a Possessed_temporal_aspect that is the use or occupation of a fixed instant, and considered to have no duration.

EXAMPLE The creation time of Vessel V4506 is a possessed_point_in_time.

EXPRESS specification:

```
*)
ENTITY possessed_point_in_time
   SUBTYPE OF (possessed_temporal_aspect);
END_ENTITY;
(*
```

7.19.5 possessed_temporal_aspect

A Possessed_temporal_aspect is a Possessed_characteristic that is the occupation or use of time.

EXAMPLE My birth time is a Possessed_temporal_aspect, possessed by me and no one else.

EXPRESS specification:

```
*)
ENTITY possessed_temporal_aspect
   SUPERTYPE OF (ONEOF (possessed_period_in_time,
                        possessed_point_in_time)
            ANDOR possessed_temporal_aspect_of_state)
   SUBTYPE OF (possessed_characteristic);
END_ENTITY;
(*
```

7.19.6 start_point_in_time_of_possessed_period_of_time

A Start_point_in_time_of_possessed_period_in_time is a Possessed_association that indicates the start_time Possessed_point_in_time is the beginning of the Possessed_period_of_time.

EXAMPLE The relationship between start of working shift 23 and Operating period 5 of the Oven C is a Start_point_in_time_of_possessed_period_of_time, indicating the oven operating period started when Shift 23 started.

EXPRESS specification:

```
*)
ENTITY start_point_in_time_of_possessed_period_of_time
   SUBTYPE OF (possessed_association);
   period     : possessed_period_in_time;
   start_time : possessed_point_in_time;
END_ENTITY;
(*
```

Attribute definitions:

period: The period specifies the Possessed_period_of_time that begins at the start_time Possessed_point_in_time.

start_time: The start_time specifies the Possessed_point_in_time that begins the period Possessed_period_of_time.

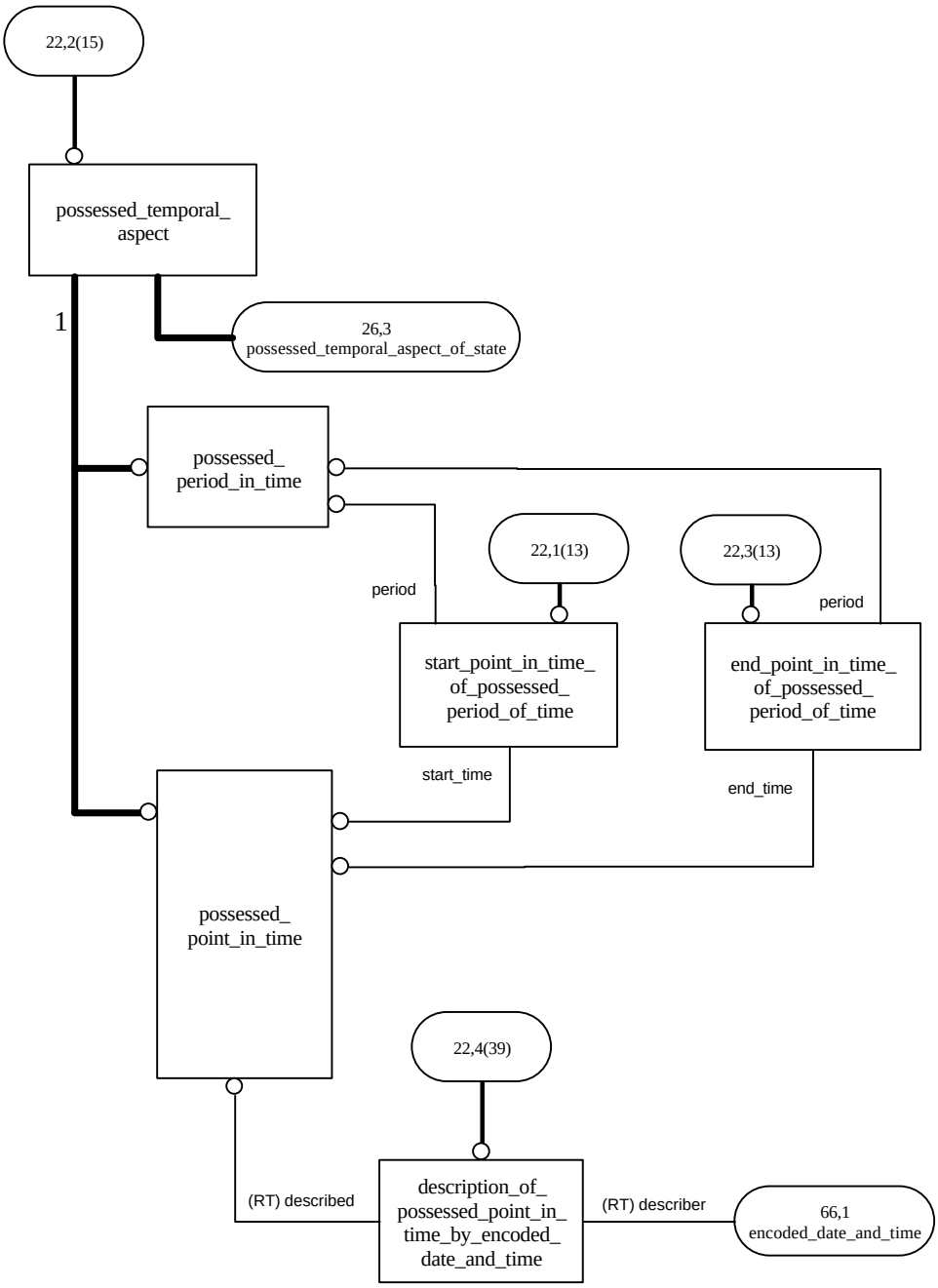


Figure 22 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed temporal aspect

7.20 Class of temporal aspect

A description of the uses of the entity types shown in this section will go here, eventually.

7.20.1 class_of_temporal_aspect

A Class_of_temporal_aspect is a Class_of_characteristic that indicates a common nature of Possessed_temporal_aspect.

EXPRESS specification:

```
*)
ENTITY class_of_temporal_aspect
   SUPERTYPE OF (ONEOF (concept_of_temporal_aspect,
                        qualified_temporal_aspect,
                        common_temporal_aspect))
   SUBTYPE OF (class_of_characteristic);
END_ENTITY;
(*
```

7.20.2 common_end_point_in_time_of_common_period_in_time

A Common_end_point_in_time_of_common_period_in_time is a Common_association that indicates the end_time members terminate one or more members of the period Common_period_in_time.

EXAMPLE The class of relationship between the Common_point_in_time "0815 2018-12-31" and the Common_period_in_time "1545 1998-10-25 to 0815 2018-12-31" that indicate members of the period class end at members of the end_time class is a Common_end_point_in_time_of_common_period_in_time.

EXPRESS specification:

```
*)
ENTITY common_end_point_in_time_of_common_period_in_time
   SUBTYPE OF (common_association);
   end_time : common_point_in_time;
   period   : common_period_in_time;
END_ENTITY;
(*
```

Attribute definitions:

end_time: The end_time specifies the Common_point_in_time whose members may terminate members of the Common_period_in_time.

The end_time role corresponds to role_1 of the Common_association cardinality data.

period: The period specifies the Common_period_in_time whose members terminate at members of the end_time Common_point_in_time.

The period role corresponds to role_2 of the Common_association cardinality data.

7.20.3 common_period_in_time

A Common_period_in_time is a Common_temporal_aspect that is a period or interval of time.

EXAMPLE The period of time from 1998-10-25 to 2018-12-31 is a Common_period_in_time.

EXPRESS specification:

```
*)
ENTITY common_period_in_time
   SUBTYPE OF (common_temporal_aspect);
END_ENTITY;
(*
```

7.20.4 common_point_in_time

A Common_point_in_time is a Common_temporal_aspect that is a point or instant in time, placed by reference to one or more time scales.

EXAMPLE The point in time of 10secs past 1030 1998-10-25 is a Common_point_in_time.

EXPRESS specification:

```
*)
ENTITY common_point_in_time
   SUBTYPE OF (common_temporal_aspect);
END_ENTITY;
(*
```

7.20.5 common_start_point_in_time_of_common_period_in_time

A Common_start_point_in_time_of_common_period_in_time is a Common_association that indicates the period members begin at the time of the start_time members.

EXAMPLE The relationship between the members of Common_point_in_time 1545 1998-10-25 and the members of Common_period_in_time 1545 1998-10-25 to 0815 2018-12-31 are members of Common_start_point_in_time_of_common_period_in_time.

EXPRESS specification:

```
*)
ENTITY common_start_point_in_time_of_common_period_in_time
   SUBTYPE OF (common_association);
   period     : common_period_in_time;
   start_time : common_point_in_time;
END_ENTITY;
(*
```

Attribute definitions:

period: The period specifies the Common_period_in_time whose members begin at the start_time Common_point_in_time.

The period role corresponds to role_1 of the Common_association cardinality data.

start_time: The start_time specifies the Common_point_in_time whose members are the beginning of members of the period Common_period_in_time.

The start_time role corresponds to role_2 of the Common_association cardinality data.

7.20.6 common_temporal_aspect

A common_temporal_aspect is a Class_of_temporal_aspect and a Common_characteristic that is a specialization of possessed_temporal_aspect that are of the same time and that may all be placed in time by reference to one or more time scales or calendars.

EXAMPLE 1 The period of time known as 2001-11-02 is a Common_temporal_aspect.

EXAMPLE 2 July 1998 is a Common_temporal_aspect.

EXAMPLE 3 July, meaning any periods of time, 31 days long following June and before August is a Common_temporal_aspect.

EXAMPLE 4 The actual start up time of the process plant X is a Possessed_temporal_aspect of plant X that is a member of the Common_temporal_aspect 2001-11-02.

EXPRESS specification:

```
*)
ENTITY common_temporal_aspect
   SUPERTYPE OF (ONEOF (common_period_in_time,
                        common_point_in_time))
   SUBTYPE OF (class_of_temporal_aspect,
               common_characteristic);
END_ENTITY;
(*
```

7.20.7 concept_of_temporal_aspect

A Concept_of_temporal_aspect is a Class_of_temporal_aspect and a Concept_of_characteristic that is a generic common nature of Possessed_temporal_aspect.

EXAMPLE 1 Period (in time) is a Concept_of_temporal_aspect.

EXAMPLE 2 Point in time is a Concept_of_temporal_aspect,

EXPRESS specification:

```
*)
ENTITY concept_of_temporal_aspect
   SUBTYPE OF (class_of_temporal_aspect,
               concept_of_characteristic);
END_ENTITY;
(*
```

7.20.8 description_of_common_point_in_time_by_encoded_date_and_time

A Description_of_common_point_in_time_by_encoded_date_and_time is a Common_association that indicates the describing Encoded_date_and_time is an identification of members of the described Common_point_in_time.

EXAMPLE The class of relationship between the common_point_in_time "1030 1998-11-02" and the Encoded_date_and_time "1030 1998-11-02" is a Description_of_common_point_in_time_by_encoded_date_and_time.

EXPRESS specification:

```
*)
ENTITY description_of_common_point_in_time_by_encoded_date_and_time
   SUBTYPE OF (common_association);
   described : common_point_in_time;
   describer : encoded_date_and_time;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Common_point_in_time whose members are identified by the Encoded_date_and_time.

The described role corresponds to role_1 of the Common_association cardinality data.

describer: The describer specifies the Encoded_date_and_time that identifies members of the described Common_point_in_time.

The describer role corresponds to role_2 of the Common_association cardinality data.

7.20.9 qualified_temporal_aspect

A qualified_temporal_aspect is a Class_of_temporal_aspect and a Qualified_characteristic that is a type of use of a Common_temporal_aspect.

A qualified_temporal_aspect may be a specialization of a Common_temporal_aspect, of an Aspect_qualifier and of a Concept_of_temporal_aspect.

EXAMPLE Friday 1600 pm shutdown time is a Qualified_temporal_aspect that is a specialization of the Common_temporal_aspect 1600pm Friday and of the Aspect_qualifier shutdown.

EXPRESS specification:

```
*)
ENTITY qualified_temporal_aspect
   SUBTYPE OF (class_of_temporal_aspect,
               qualified_characteristic);
END_ENTITY;
(*
```

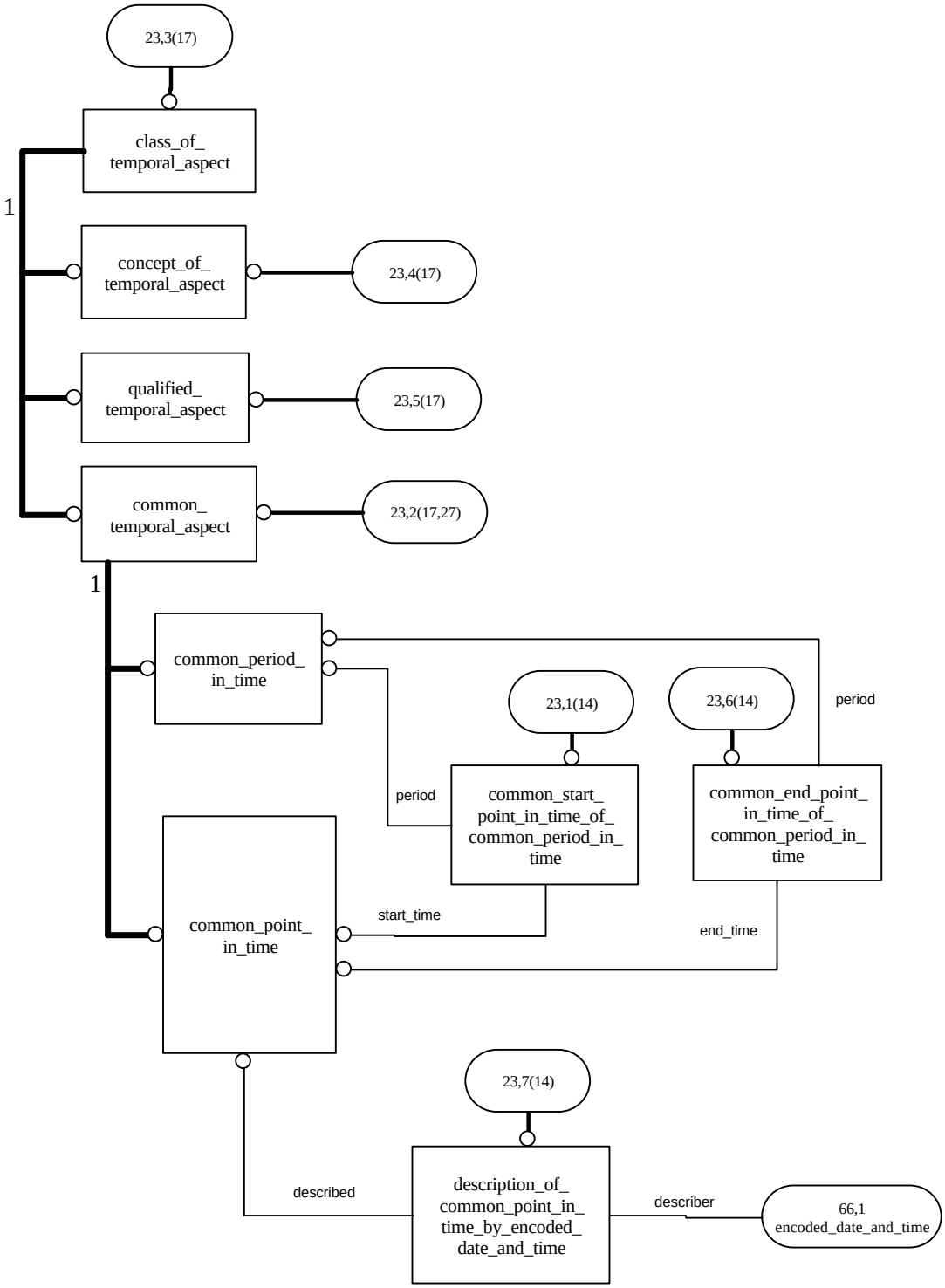


Figure 23 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of temporal aspect

```
(*
```

7.21 Class of count

A description of the uses of the entity types shown in this section will go here, eventually.

7.21.1 class_of_count

A Class_of_count is a Class_of_characteristic that is a common nature of some members of Possessed_count.

EXAMPLE 1 "number of pumps" is a Class_of_count and a Qualified_count.

EXAMPLE 2 "6" is a Class_of_count and a Common_count.

EXPRESS specification:

```
*)
ENTITY class_of_count
      ABSTRACT SUPERTYPE OF (ONEOF (concept_of_count,
                                    qualified_count,
                                    common_count))
   SUBTYPE OF (class_of_characteristic);
END_ENTITY;
(*
```

7.21.2 common_count

A Common_count is a Class_of_count and a Common_characteristic that is a positive whole number.

EXAMPLE The number 6 is a Common_count.

EXPRESS specification:

```
*)
ENTITY common_count
   SUBTYPE OF (class_of_count,
               common_characteristic);
END_ENTITY;
(*
```

7.21.3 concept_of_count

A Concept_of_count is a Class_of_count and a Concept_of_characteristic that is a common generic nature of Possessed_counts.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY concept_of_count
   SUBTYPE OF (class_of_count,
               concept_of_characteristic);
END_ENTITY;
(*
```

7.21.4 qualified_count

A Qualified_count is a Class_of_count and a Qualified_characteristic that is the nature or circumstances of the use of a Possessed_count and the magnitude of the count.

A Qualified_count is a specialization of a Common_count and of an Aspect_qualifier.

EXAMPLE A minimum stock level of 10 is a Qualified_count, possessed by a Stock, that is a specialisation of the common_count "10" and of the Aspect_qualifier "minimum" .

EXPRESS specification:

```
*)
ENTITY qualified_count
   SUBTYPE OF (class_of_count,
               qualified_characteristic);
END_ENTITY;
(*
```

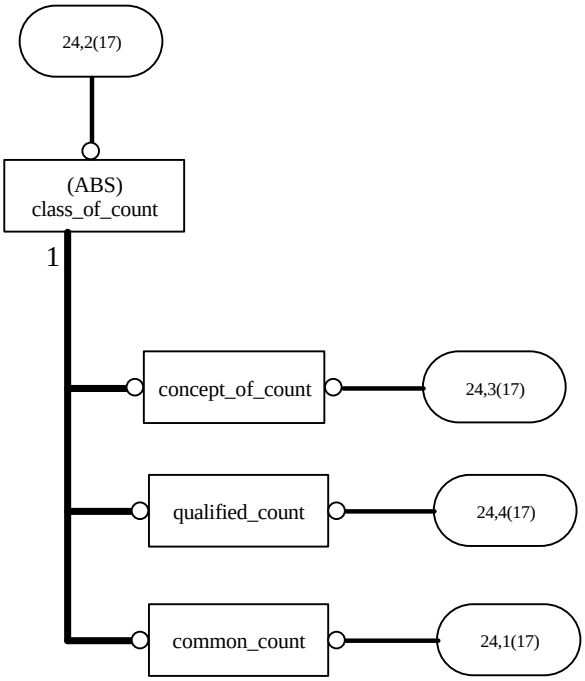


Figure 24 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of count

7.22 Class of quality

A description of the uses of the entity types shown in this section will go here, eventually.

7.22.1 class_of_atomic_and_subatomic_structure

A Class_of_atomic_and_subatomic_structure is a Class_of_quality that is a specialization of Possessed_atomic_and_subatomic_structure that indicates a common nature of arrangements of atoms.

EXAMPLE 1 Butane is a Class_of_atomic_and_subatomic_structure.

EXAMPLE 2 Water is a Class_of_atomic_and_subatomic_structure.

EXAMPLE 3 Quartz is a Class_of_atomic_and_subatomic_structure.

EXAMPLE 4 Steel is a Class_of_atomic_and_subatomic_structure.

EXPRESS specification:

```
*)
ENTITY class_of_atomic_and_subatomic_structure
   SUBTYPE OF (class_of_quality);
END_ENTITY;
(*
```

7.22.2 class_of_phase

A Class_of_phase is a Class_of_quality that is a specialization of Possessed_phase that indicates a common nature for the boundary behaviour of materials.

EXAMPLE Liquid is a Class_of_phase.

EXPRESS specification:

```
*)
ENTITY class_of_phase
   SUBTYPE OF (class_of_quality);
END_ENTITY;
(*
```

7.22.3 class_of_quality

A Class_of_quality is a Class_of_characteristic that is a common nature of Possessed_quality.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY class_of_quality
   ABSTRACT SUPERTYPE OF (ONEOF (class_of_atomic_and_subatomic_structure,
                                 class_of_phase)
            ANDOR ONEOF (concept_of_quality,
                         qualified_quality,
                         common_quality))
   SUBTYPE OF (class_of_characteristic);
END_ENTITY;
(*
```

7.22.4 common_quality

A Common_quality is a Class_of_quality and a Common_characteristic that is ??

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_quality
   SUBTYPE OF (class_of_quality,
               common_characteristic);
END_ENTITY;
(*
```

7.22.5 concept_of_quality

A Concept_of_quality is a Class_of_quality and a Concept_of_characteristic that is ??

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY concept_of_quality
   SUBTYPE OF (class_of_quality,
               concept_of_characteristic);
END_ENTITY;
(*
```

7.22.6 qualified_quality

A qualified_quality is a Class_of_quality and a Qualified_characteristic that is:

a) a specialization of an Aspect_qualifier class indicating the circumstances in which the Possessed_quality members exist, and

b) a specialization of a Common_quality that indicates how the member Possessed qualities compare to other possessed qualities.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY qualified_quality
   SUBTYPE OF (class_of_quality, qualified_characteristic);
END_ENTITY;
(*
```

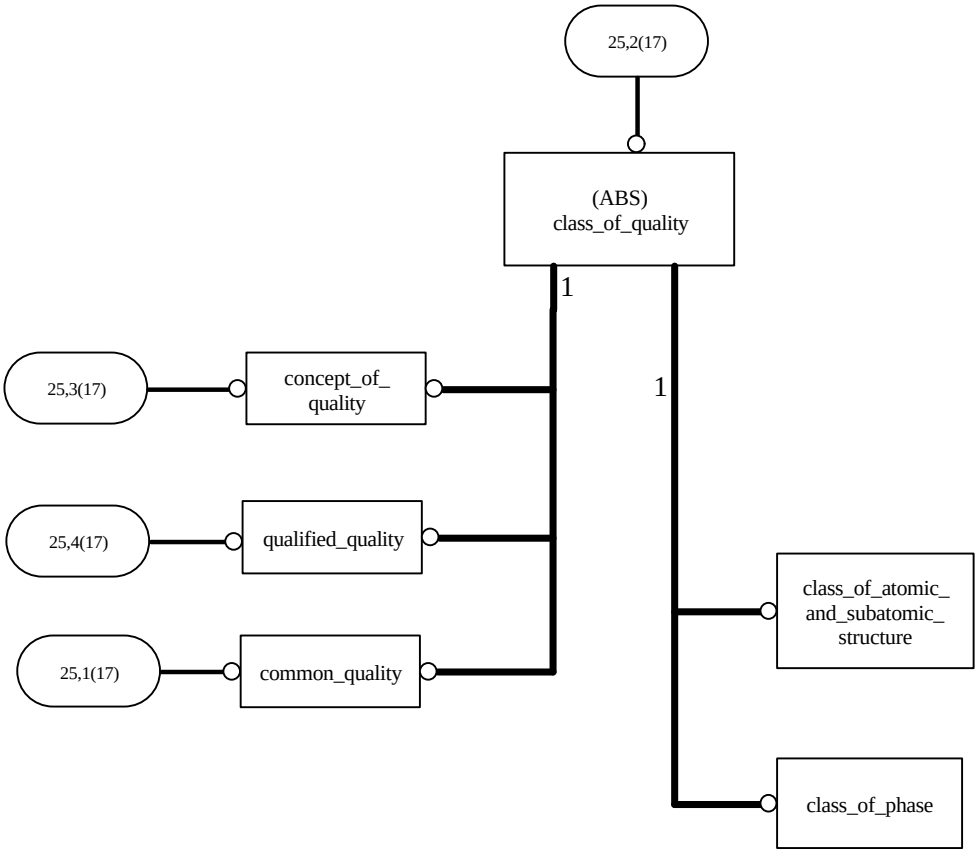


Figure 25 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of quality

7.23 Possessed state

A description of the uses of the entity types shown in this section will go here, eventually.

7.23.1 change_of_possessed_state

A Change_of_possessed_state is a Possessed_association that indicates the values of the Possessed_state have changed.

This provokes the issue of how many values can a possessed state have and does a possessed state have parts that corresponf to different times with one set of values.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY change_of_possessed_state
   SUBTYPE OF (possessed_association);
   poststate : possessed_state;
   prestate  : possessed_state;
END_ENTITY;
(*
```

Attribute definitions:

poststate: The poststate specifies the Possessed_state that the prestate was transformed to.

prestate: The prestate specifies the Possessed_state that was transformed to the poststate.

7.23.2 essential_classification_of_possessed_state

An Essential_classification_of_possessed_state is an Essential_classification_of_possessed_aspect that classifies a Possessed_state.

EXAMPLE 1 The relationship between the Possessed_state that consists of the openness of valves V1 and V2 and the Class_of_state "Valve position" that indicates the Possessed state is a member of the class is an Essential_classification_of_possessed_state

EXAMPLE 2 The relationship between the thermodynamic state possessed by the material and the Class_of_state "thermodynamic" that indicates the possessed state is a member of the class is an Essential_classification_of_possessed_state.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_possessed_state
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : possessed_state;
   SELF\classification_of_individual.classifier : class_of_state;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Possessed_state that is a member of the classifier Class_of_state.

classifier: The classifier specifies the Class_of_state the classified is a member of.

7.23.3 possessed_state

A Possessed_state is an Aspect_possessed_by_individual that is a composition of Possessed_aspect of the same possessor.

EXAMPLE 1 A Possessed_state of the system that contains two valves might be the openness of Valve 1 and the openness of valve 2.

EXAMPLE 2 A thermodynamic state that consists of the temperature, pressure and volume of a material is a Possessed_state.

EXPRESS specification:

```
*)
ENTITY possessed_state
   SUBTYPE OF (aspect_possessed_by_individual);
END_ENTITY;
(*
```

7.23.4 possessed_temporal_aspect_of_state

A Possessed_temporal_aspect_of_state is a Possessed_temporal_aspect that is possessed by a Possessed_state.

EXAMPLE 1 The duration of a Possessed_state is a Possessed_temporal_aspect_of_state.

EXAMPLE 2 The end of a possessed_state is a Possessed_temporal_aspect_of_state.

EXPRESS specification:

```
*)
ENTITY possessed_temporal_aspect_of_state
   SUBTYPE OF (possessed_temporal_aspect);
   SELF\aspect_possessed_by_individual.possessor : possessed_state;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Possessed_state that possesses the Possessed_temporal_aspect_of_state.

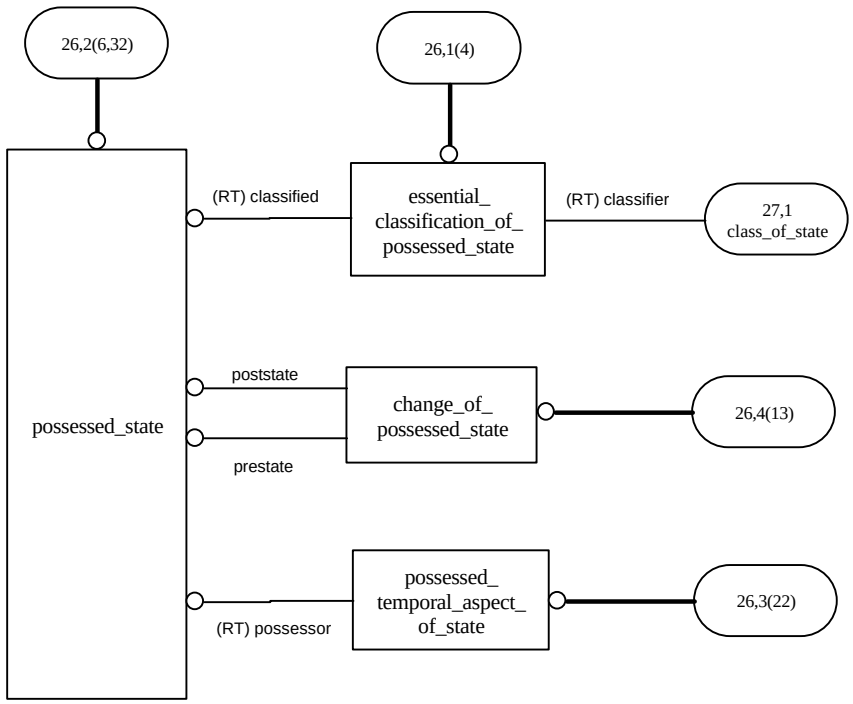


Figure 26 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed state

7.24 Class of state

A description of the uses of the entity types shown in this section will go here, eventually.

7.24.1 class_of_state

A Class_of_state is a Class_of_aspect that indicates a common nature of Possessed_state.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY class_of_state
   ABSTRACT SUPERTYPE OF (ONEOF (concept_of_state,
                                 qualified_state,
                                 common_state))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.24.2 common_change_of_state

A Common_change_of_state is a Common_association that is a specialization of Change_of_possessed_state that indicates that members of the prestate class may change or undergo transformation to members of the post-state class.

EXAMPLE ????

EXPRESS specification:

```
*)
ENTITY common_change_of_state
   SUBTYPE OF (common_association);
   poststate : common_state;
   prestate  : common_state;
END_ENTITY;
(*
```

Attribute definitions:

poststate: The poststate specifies the Common_state whose members may be the result of transformation from a member of the prestate class.

The poststate corresponds to Role_1 of the Common_association cardinality constraints.

prestate: The prestate specifies the Common_state whose members may be transformed to members of the post-state Common_state.

The prestate corresponds to Role 2 of the Common_association cardinality data.

7.24.3 common_possession_of_temporal_aspect_by_state

A Common_possession_of_temporal_aspect_by_state is a Common_association that indicates that the members of the possessor Common_state possess members of the possessed Common_temporal_aspect.

EXAMPLE ???

EXPRESS specification:

```
*)
ENTITY common_possession_of_temporal_aspect_by_state
   SUBTYPE OF (common_association);
   possessed : common_temporal_aspect;
   possessor : common_state;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Common_temporal_aspect whose members are possessed by members of the possessor Common_state.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Common_state whose members possess members of the possessed Common_temporal_aspect.

The possessor role corresponds to role_2 of the Common_association cardinality data.

7.24.4 common_state

A Common_state is a Class_of_state and a Common_aspect where the Possessed_state members have a common set of values.

EXAMPLE: ??

EXPRESS specification:

```
*)
ENTITY common_state
   SUBTYPE OF (class_of_state,
               common_aspect);
END_ENTITY;
(*
```

7.24.5 concept_of_state

A Concept_of_state is a Class_of_state and a Concept_of_aspect that indicates a generic common nature of Possessed_state.

EXAMPLE ???

EXPRESS specification:

```
*)
ENTITY concept_of_state
   SUBTYPE OF (class_of_state,
               concept_of_aspect);
END_ENTITY;
(*
```

7.24.6 qualified_state

A Qualified_state is a Class_of_state and a Qualified_aspect. A Qualified_state is a specialisation of a Common_state, indicating some common condition, and of a Qualified_aspect, indicating some common circumstance of the state.

EXAMPLE:

EXPRESS specification:

```
*)
ENTITY qualified_state
   SUBTYPE OF (class_of_state,
               qualified_aspect);
END_ENTITY;
(*
```

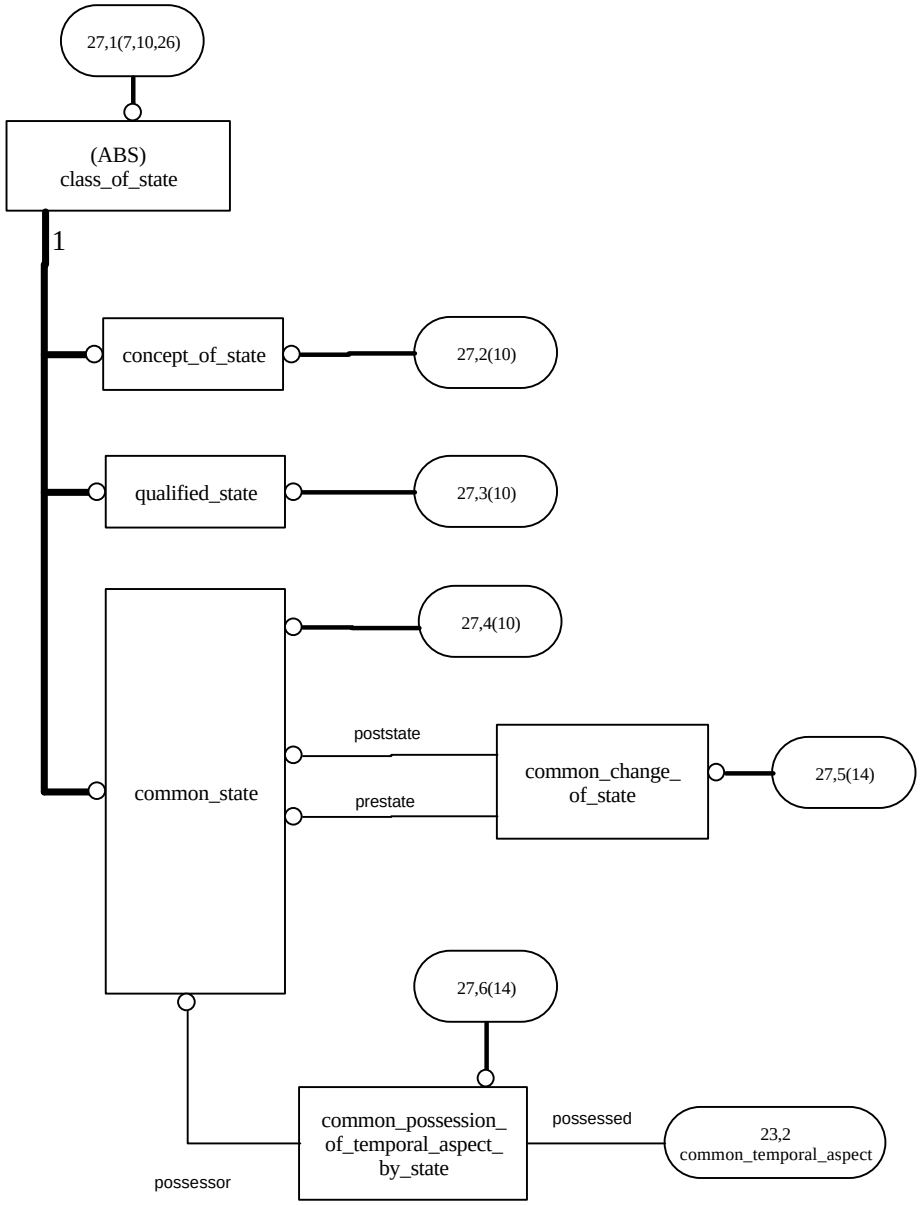


Figure 27 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of state

7.25 Class of mathematical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.25.1 class_of_mathematical_object

Definitions and examples not yet available.

EXPRESS specification:

```
*)
ENTITY class_of_mathematical_object
   ABSTRACT SUPERTYPE OF (ONEOF (concept_of_mathematical_object,
                                 qualified_mathematical_object,
                                 common_mathematical_object))
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.25.2 common_mathematical_object

Definitions and examples not yet available.

EXPRESS specification:

```
*)
ENTITY common_mathematical_object
   SUBTYPE OF (common_aspect,
               class_of_mathematical_object);
END_ENTITY;
(*
```

7.25.3 concept_of_mathematical_object

Definitions and examples not yet available.

EXPRESS specification:

```
*)
ENTITY concept_of_mathematical_object
   SUBTYPE OF (concept_of_aspect,
               class_of_mathematical_object);
END_ENTITY;
(*
```

7.25.4 mathematical_function

Definitions and examples not yet available.

EXPRESS specification:

```
*)
ENTITY mathematical_function
   SUBTYPE OF (common_association);
   invaraible : common_mathematical_object;
   variable   : common_mathematical_object;
END_ENTITY;
(*
```

Attribute definitions:

invaraible: Definitions and examples not yet available. variable: Definitions and examples not yet available.

7.25.5 qualified_mathematical_object

Definitions and examples not yet available.

EXPRESS specification:

```
*)
ENTITY qualified_mathematical_object
   SUBTYPE OF (class_of_mathematical_object, qualified_aspect);
END_ENTITY;
(*
```

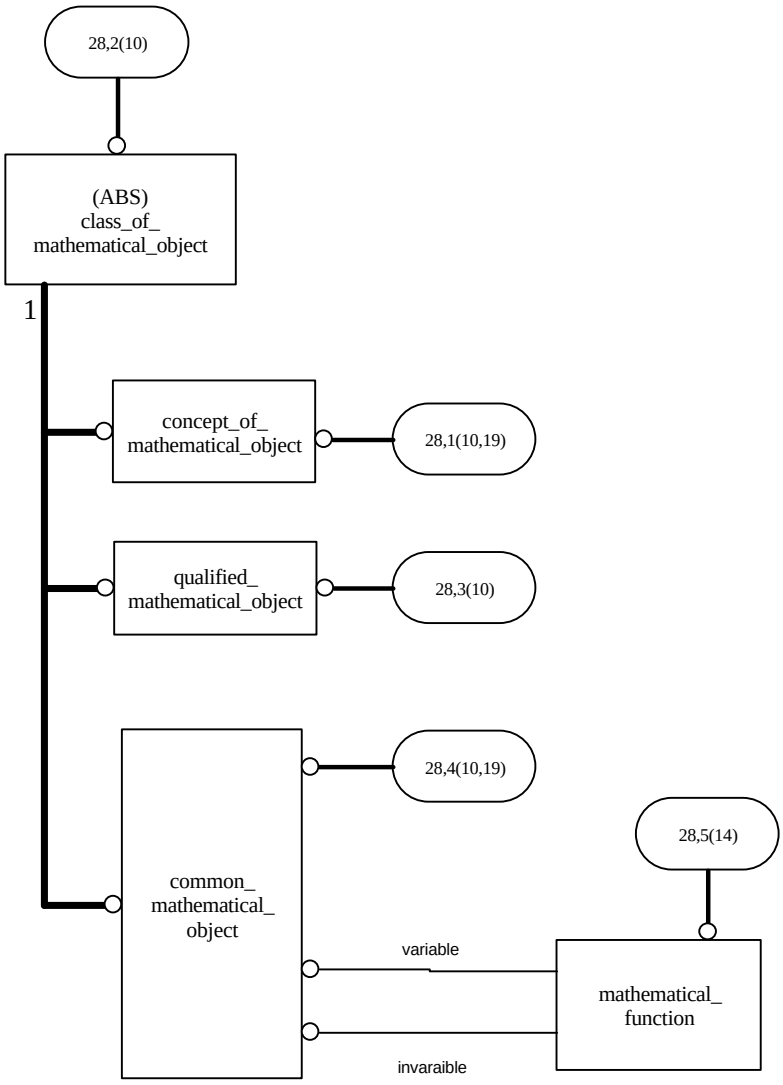


Figure 28 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of mathematical object

7.26 Possessed event effect

A description of the uses of the entity types shown in this section will go here, eventually.

7.26.1 activity_or_possessed_event_effect

An Activity_or_possessed_event_effect is an Activity or a Possessed_event_effect.

EXPRESS specification:

```
*)
TYPE activity_or_possessed_event_effect = SELECT
  (activity,
   possessed_event_effect);
END_TYPE;
(*
```

7.26.2 possessed_begin_effect

A Possessed_beginning_effect is a Possessed_event_effect that is the beginning of the existence of an individual.

EXAMPLE The beginning of life of the actual vessel V-4506 is a Possessed_beginning_effect and a Possessed_actual_aspect that is possessed by the vessel.

EXPRESS specification:

```
*)
ENTITY possessed_begin_effect
   SUBTYPE OF (possessed_event_effect);
END_ENTITY;
(*
```

7.26.3 possessed_end_effect

A Possessed_end_effect is a Possessed_event_effect that is the end of the existence of an individual.

EXAMPLE The end of life or destruction of the actual vessel V-4506 is a Possessed_end_effect and a Possessed_actual_aspect that is possessed by the vessel.

EXPRESS specification:

```
*)
ENTITY possessed_end_effect
   SUBTYPE OF (possessed_event_effect);
END_ENTITY;
(*
```

7.26.4 possessed_event_effect

A Possessed_end_effect is a Possessed_aspect that indicates the beginning or end of the existence of an individual.

EXAMPLE The operating plan for a plant for the month of May specified the set point pressure of the control valve V1 to be 15 bar gauge. The plan was revised and a new set point pressure of 16 bar gauge specified. The plant is a Whole, and the plans different Possessed_planned_aspect of the plant Whole. The first plan is terminated by a possessed_end_effect caused by the plan revision activity. The second plan possesses a begin effect that is also caused by the plan revision activity.

EXPRESS specification:

```
*)
ENTITY possessed_event_effect
   ABSTRACT SUPERTYPE OF (ONEOF (possessed_begin_effect,
                                 possessed_end_effect))
   SUBTYPE OF (aspect_possessed_by_individual);
   cause : OPTIONAL activity_or_possessed_event_effect;
END_ENTITY;
(*
```

Attribute definitions:

cause: The cause specifies the Activity or other Possessed_event_effect that is the cause of the Possessed_event_effect.

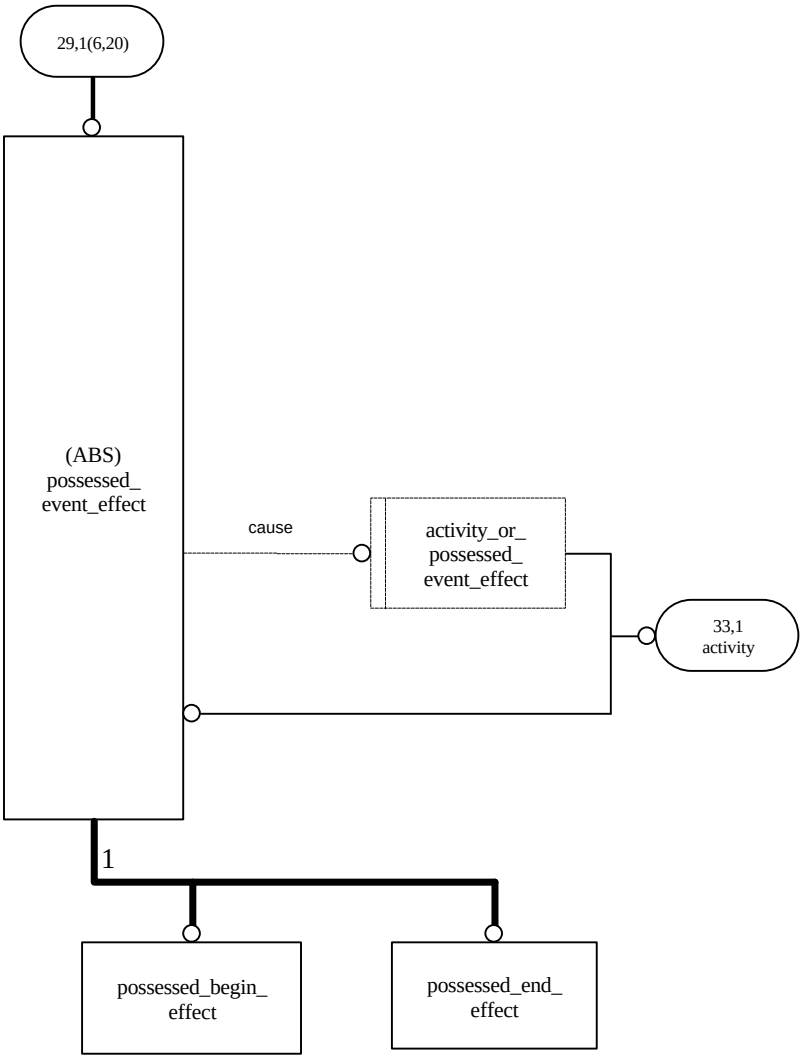


Figure 29 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Possessed end effect

7.27 Identification of application object

A description of the uses of the entity types shown in this section will go here, eventually.

7.27.1 identification_of_object_by_encoded_information

An Identification_of_object_by_encoded_information is a Possessed_association that indicates that the Encoded_information can be used to reference the Application_object.

It is not necessary for an Application_object to be identified. An Application_object may have several identifiers. An encoded_information may be the identifier of several Application_objects.

EXAMPLE The association between the valve V-4506 and the Textual_object 'V-4506' that indicates 'V-4506' may be used a reference for the valve is an Identification_of_object_by_encoded_information.

EXPRESS specification:

```
*)
ENTITY identification_of_object_by_encoded_information
   SUBTYPE OF (possessed_association);
   identified : application_object;
   identifier : encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

identified: The identified specifies the Apllication_object that can be referenced using the Encoded_information.

identifier: The identifier specifies the Encoded_information that is a reference the identified Application_object.

7.27.2 registration_of_identification_with_organisation

A Registration_of_identification_aspect_with_organization is a Possessed_association that indicates the registered identification-of_object_by_encoded_information has been recorded by the registrar organization.

EXAMPLE The relationship between the valve V-4506 and the Textual_object 'V-4506' that indicates 'V-4506' may be used a reference fot the valve is an Identification_of_object_by_encoded_information. The relationship between this identification association and the Organisation XYZ Co. indicating the identification is registered with the XYZ Co. is a Registration_of_identification_with_organsiation.

EXPRESS specification:

```
*)
ENTITY registration_of_identification_with_organisation
   SUBTYPE OF (possessed_association);
   registrar  : organization;
   registered : identification_of_object_by_encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

registrar: The registrar specifies the Organisation that records the registered identification.

registered: The registered specifies the identification association that is registered by the registrar organization.

7.27.3 uniqueness_context_for_identification

A Uniquneness_context_for_identification is a Possessed_association that indicates the identification is a unique reference for the identified Application_object within the context Application_object.

If the context is a Class then the identification enables the identified object to be selected from amongst the members of the class. If the context is a Plural_individual, the identification enables the identified object to be selected from amongst its parts.

EXAMPLE The relationship between the Class_of_class that is the pump types manufactured by the XYZ Co. and the identification_of_object_by_encoded_information that indicates that the JBC_500 model type is identified by the text JBC_500, where JBC_500 is a unique name within the XYZ Co pump types, is a Uniqueness_context_for_identification.

EXPRESS specification:

```
*)
ENTITY uniqueness_context_for_identification
   SUBTYPE OF (possessed_association);
   context_set    : application_object;
   identification : identification_of_object_by_encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

context_set: The context_set specifies the class or set Application_object within which the identification is unique.

identification: The identification specifies the identification_of_object_by_encoded_information that is unique within the context objects.

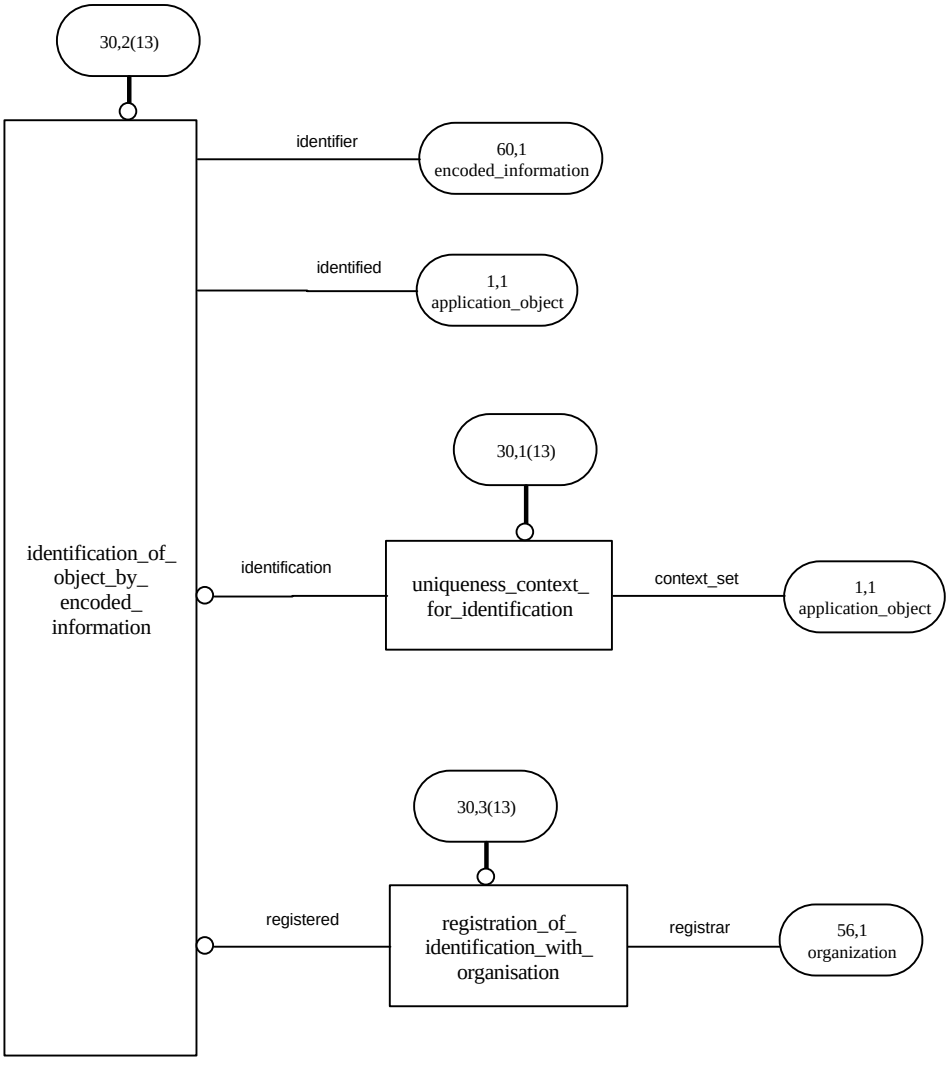


Figure 30 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Identification of application object

7.28 Identification of ISO 13584 class

This section is deliberately omitted.

7.29 Derivation,version, alternative and succession

A description of the uses of the entity types shown in this section will go here, eventually.

7.29.1 alternative_association_between_objects

An Alternative_association_between_objects is a Possessed_association that indicates that either the alternative _1 or the alternative_2 can be used for some purpose. Note that the purpose can be specified using Purpose_of_possessed_aspect.

EXAMPLE The relationship between the Class_of_physical_object that is a XYZ Co Pump type 2 and the Class_of_physical_object that is a XYZ Co pump type 2b that indicates that the types 2 and 2b are interchangeable for sales purposes is an Alternative_association_between_objects.

EXPRESS specification:

```
*)
ENTITY alternative_association_between_objects
   SUBTYPE OF (possessed_association);
   alternative_1 : application_object;
   alternative_2 : application_object;
END_ENTITY;
(*
```

Attribute definitions:

alternative_1: The alternaive_1 specifies the Application_object that is the alternative to the alternative_2 Application_object.

alternative_2: The alternaive_2 specifies the Application_object that is the alternative to the alternative_1 Application_object.

7.29.2 derivation_association_between_objects

A Derivation_association_between_objects is a Possessed_association that indicates that the derived application_object has been obtained by referring to the source application object. Note that, aside from quantum mechanical effects, the source is unaffected by the derivation.

EXAMPLE 1 The relationship between the Class_of_physical_object that is an XYZ Co Mark 2 pump and a Class_of_physical_object that is an XYZ Co. Mark 2b pump that indicates the Mark2b specification and design was obtained by developing the Mark 2
specification and design is a Derivation_association_between_objects.

EXAMPLE 2 Photocopying, photography and other forms of replication and reproduction are examples of derivation.

EXPRESS specification:

```
*)
ENTITY derivation_association_between_objects
   SUBTYPE OF (possessed_association);
   derivative : application_object;
   source     : application_object;
END_ENTITY;
(*
```

Attribute definitions:

derivative: The derivative specifies the Application_object that results from referring to the source Application_object.

source: The source specifies the Application_object that the derivative Application_object is based on.

7.29.3 succession_association_between_objects

A Succession_association_between_objects is a Possessed_association that indicates the successor Application_object replaces the predecessor Application_object in some unspecified role.

EXAMPLE The relationship between Plan 1 and Plan 2 of a distillate transfer system that indicates that Plan 2 will be used instead of Plan 1 in future is a Succession_association_between_objects.

EXPRESS specification:

```
*)
ENTITY succession_association_between_objects
   SUBTYPE OF (possessed_association);
   predecessor : application_object;
   successor   : application_object;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Application_object that is or been replaced in the performance of some role by the successor Application_object.

successor: The successor specifies the Application_object that replaces the predecessor Application_object in performing some role.

7.29.4 version_association_between_objects

A Version_association_between_objects is a Possessed_association that indicates the version Application_object is a version of the original Application_object. Here the meaning of version is something a little different from another of the same type.

EXAMPLE An experimental version of the stealth bomber.

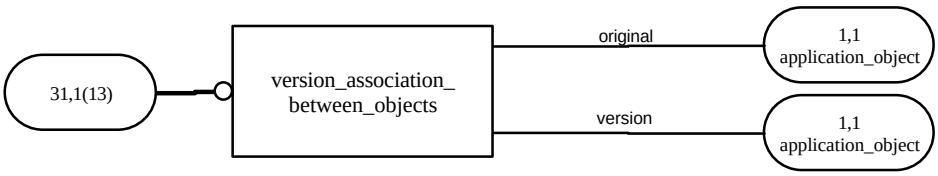
EXPRESS specification:

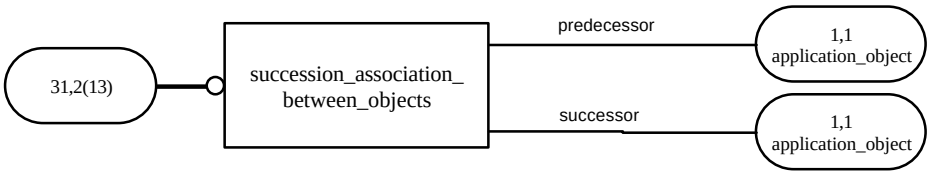
```
*)
ENTITY version_association_between_objects
   SUBTYPE OF (possessed_association);
   original : application_object;
   version  : application_object;
END_ENTITY;
(*
```

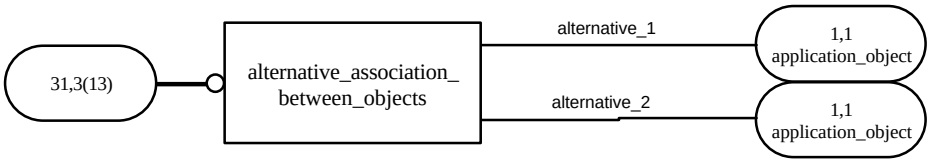
Attribute definitions:

original: The original specifies the Application_object that is the basis for the version application_object.

version: The version specifies the Application_object that is a version of the original.


31,1(13)
version_association_
between_objects
original
version
1,1
application_object
1,1
application_object


31,2(13)
succession_association_
between_objects
predecessor
successor
1,1
application_object
1,1
application_object


31,3(13)
alternative_association_
between_objects
alternative_1
alternative_2
1,1
application_object
1,1
application_object

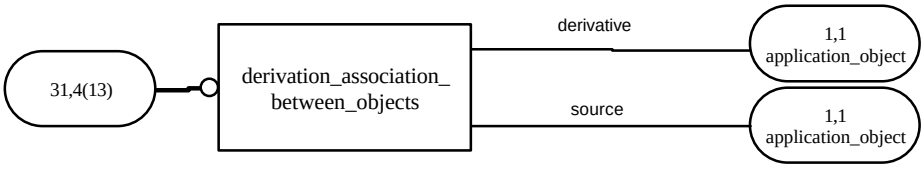

31,4(13)
derivation_association_
between_objects
derivative
source
1,1
application_object
1,1
application_object

Figure 31 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Derivation,version, alternative and succession

7.30 Approval

A description of the uses of the entity types shown in this section will go here, eventually.

7.30.1 approval_of_object

An Approval_of_object is a Possessed_association that indicates the approved Application_object has an approved or not approved status given by the approver person or organization.

EXAMPLE 1 The relationship between the Activity "planned maintenance shut down" and the Organization "plant manager" that indicates that the shutdown and maintenance is approved by the Plant Manager is an Approval_of_object.

EXAMPLE 2 The relationship between the Class_of_activity "Safe practices" and the Organisation "plant manager" that indicates that the plant safe practice rules are approved by the plant manager is an Approval_of_object. Note that this is not an approval of any of its members.

EXPRESS specification:

```
*)
ENTITY approval_of_object
   SUBTYPE OF (possessed_association);
   approved : application_object;
   approver : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

approved: The approved specifies the Application_object that is approved or not approved by the approver.

approver: The approver specifies the Person or Organization that approves the approved Application_object

7.30.2 approval_of_possessed_state

An Approval_of_possessed_state is an Approval_of_object that indicates the approved Possessed_state has an approved or not approved status given by the approver person or organization.

EXPRESS specification:

```
*)
ENTITY approval_of_possessed_state
   SUBTYPE OF (approval_of_object);
   SELF\approval_of_object.approved : possessed_state;
END_ENTITY;
(*
```

Attribute definitions:

approved: The approved specifies the Application_object that is approved or not approved by the approver.

7.30.3 common_purpose_of_approval

A Common_purpose_of_approval is a Common_purpose_of_possessed_aspect that is a specialization of Purpose_of_approval that indicates the purpose of approval of the aspect Application_object is a member of the purpose Class_of_activity.

EXAMPLE 1 The class of relationship between the Physical_object "prototype 5" and the Class_of_activity "testing" that indicates the prototype is approved for testing where testing is a general class of activity is a Common_purpose_of_approval.

EXAMPLE 2 The class of relationship between the Physical_object "this pack of sandwiches" and the Class_of_activity "Sales before 1999-07-31" that indicates that the sandwiches are approved for sale before 1999-07-31 is a Common_purpose_of_approval.

EXPRESS specification:

```
*)
ENTITY common_purpose_of_approval
   SUBTYPE OF (common_purpose_of_possessed_aspect);
   SELF\common_purpose_of_possessed_aspect.aspect : approval_of_object;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Approval_of_object that is given for the purpose.

The aspect role corresponds to Role_1 of the Common_association cardinality data.

7.30.4 purpose_of_approval

A Purpose_of_approval is a Purpose_of_possessed_aspect that indicates the purpose of the approval status.

EXAMPLE 1 The relationship between the Approval_of_object "approval of the maintenance plan by plant manager" and the Activity "execution of maintenance plan" indicating the approval is for execution is a Purpose_of_approval.

EXPRESS specification:

```
*)
ENTITY purpose_of_approval
   SUBTYPE OF (purpose_of_possessed_aspect);
   SELF\purpose_of_possessed_aspect.aspect : approval_of_object;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Approval_of_object that is given for the purpose.

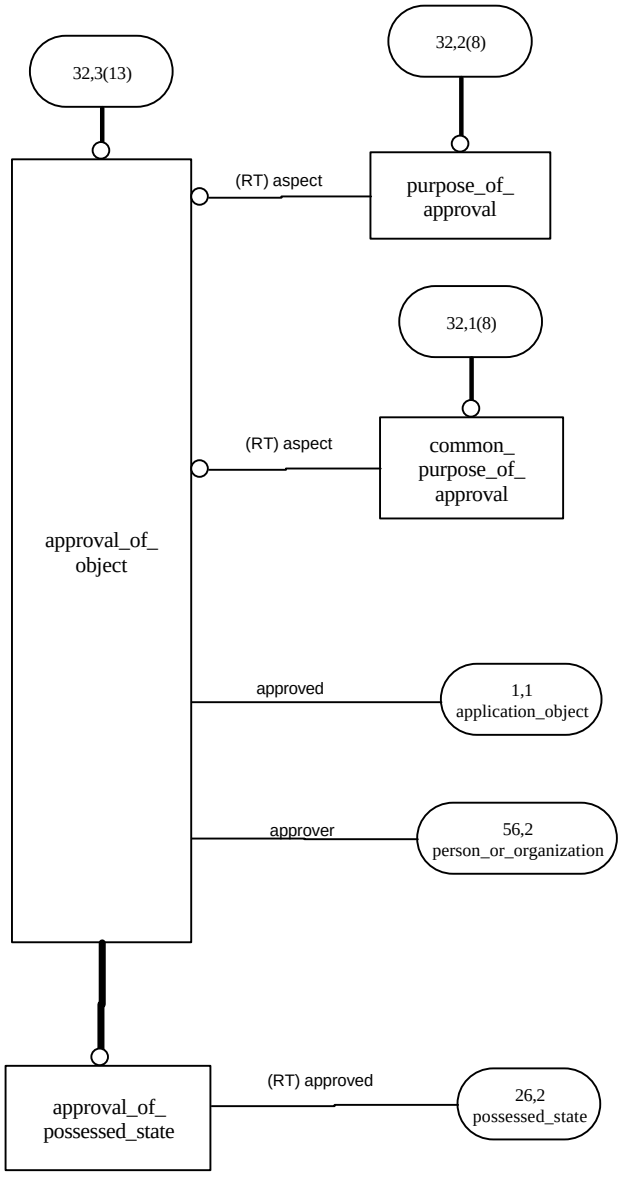


Figure 32 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Approval

7.31 Activity

A description of the uses of the entity types shown in this section will go here, eventually.

7.31.1 activity

An Activity is an Individual that is a process that makes a change to the universe.

EXAMPLE 1 The designing of the process plant is an Activity.

EXAMPLE 2 The operating of the process plant during May 1998 is an Activity.

EXAMPLE 3 The inspecting of the pressure vessel V-4506 in 1998 is an Activity and and a Specific_individual and a Whole.

EXAMPLE 4 The planned inspecting of pressure vessel V-4506 is an Activity and a Possessed_planned_aspect.

EXPRESS specification:

```
*)
ENTITY activity
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.31.2 classification_of_involvement_by_role

A Classification_of_involvement_by_role is an Essential_classification_of_individual that indicates the nature of the classified Involvement_of_object_in_activity.

EXAMPLE The relationship between the Involvement_of_object_in_activity that is between the pump P-4506 and the distillate transfer activity, and the class_of_role "performer" is a Classification_of_involvement_by_role.

EXPRESS specification:

```
*)
ENTITY classification_of_involvement_by_role
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified :
      involvement_of_object_in_activity;
   SELF\classification_of_individual.classifier : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Involvement_of_object_in_activity that is a member of the Class_of_role.

classifier: The classifier specifies the Class_of_role the classified is a member of.

7.31.3 essential_classification_of_activity

An Essential_classification_of_activity is an Essential_classification_of_individual that indicates the essential nature of an activity.

EXAMPLE The activity of inspecting vessel V-4506 is essentially classified as an inspecting activity. If the inspecting nature terminates, then the activity stops and another activity of a different type starts.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_activity
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : activity;
   SELF\classification_of_individual.classifier : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Activity that is a member of the classifier Class_of_activity.

classifier: The classifier specifies the Class_of_activity that the classified is a member of.

7.31.4 involvement_of_object_in_activity

An involvement_of_object_in_activity is a Possessed_association that indicates the involved Application_object plays a role or somehow takes part in the activity.

EXAMPLE 1 The relationship between vessel V-4506 and the activity separating well head stream 6 on Monday 5th May that indicates the vessel was involved in this activity is an Involvement_of_object_in_activity.

EXAMPLE 2 The relationship between the Functional_physical_object "pump P-4506A" and the Activity "pumping distillate from Tower B" that indicates the pump is involved in the pumping is an Involvement_of_object_in_activity.

EXPRESS specification:

```
*)
ENTITY involvement_of_object_in_activity
   SUBTYPE OF (possessed_association);
   involved : application_object;
   involver : activity;
END_ENTITY;
(*
```

Attribute definitions:

involved: The involved specifies the Application_object that plays a role in the activity.

involver: The involver specifies the Activity that the involved object plays a role in.

7.31.5 temporal_sequence_of_activity

A Temporal_sequence_of_activity is a Possessed_association that indicates the predecessor Activity ends at a time that is before the start of the successor Activity.

EXAMPLE The relationship between a specification Activity and an approval Activity that indicates that the approval Activity starts after the specification Activity is complete is a Temporal_sequence_of_Activity.

EXPRESS specification:

```
*)
ENTITY temporal_sequence_of_activity
   SUBTYPE OF (possessed_association);
   predecessor : activity;
   successor   : activity;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Activity that ends before the successor Activity begins.

successor: The successor specifies the Activity that begins after the predecessor Activity ends.

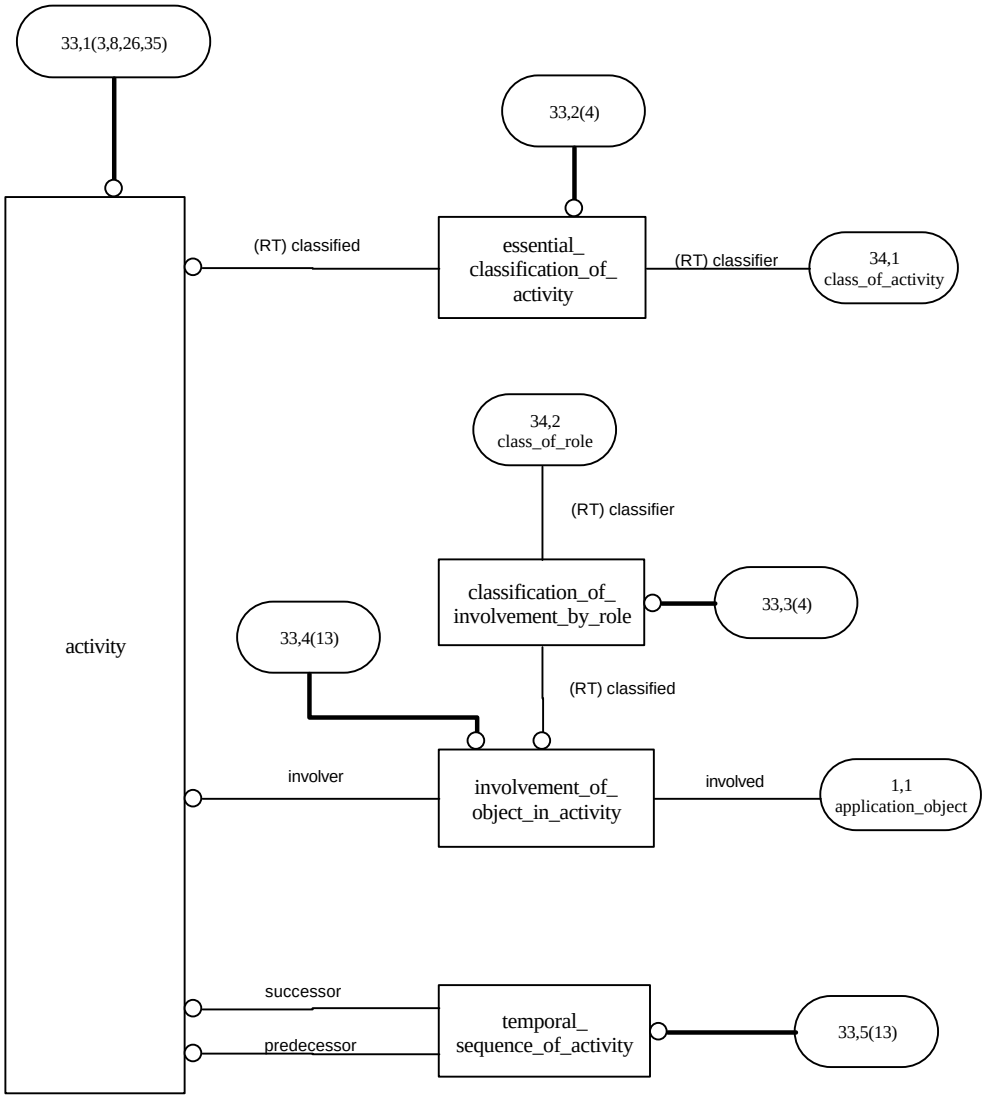


Figure 33 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Activity

7.32 Class of activity

A description of the uses of the entity types shown in this section will go here, eventually.

7.32.1 class_of_activity

A Class_of_activity is a Class_of_individual that indicates a common nature of Activity.

EXAMPLE 1 Pumping, meaning to cause a fluid to flow, is a Class_of_activity.

EXAMPLE 2 Inspecting, meaning to look over carefully, or scrutinize in order to verify, is a Class_of_activity.

EXPRESS specification:

```
*)
ENTITY class_of_activity
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.32.2 class_of_role

A Class_of_role is a Class_of_aspect that indicates a common nature of: the use something is put to; or what something does.

EXAMPLE 1 Pump is a Class_of_role.

EXAMPLE 2 Customer is a Class_of_role.

EXAMPLE 3 Performer is a Class_of_role.

EXAMPLE 4 Problem is a Class_of_role.

EXPRESS specification:

```
*)
ENTITY class_of_role
   SUBTYPE OF (class_of_aspect);
END_ENTITY;
(*
```

7.32.3 common_role_in_activity

A Common_role_in_activity is a Common_association that indicates the activity class members have roles that are members of the Class_of_role.

EXAMPLE The class of relationship between the Class_of_activity "pumping" and the Class_of_role "pump" indicating that pumping activities involve the role of pump is a Common_role_in_activity.

EXPRESS specification:

```
*)
ENTITY common_role_in_activity
   SUBTYPE OF (common_association);
   activity : class_of_activity;
   role     : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

activity: The activity specifies the Class_of_activity whose members have roles that are members of the role class.

The activity role corresponds to role_1 of the Common_association cardinality data.

role: The role specifies the Class_of_role whose members are involved with members of the activity class.

The role role corresponds to role_2 of the Common_association cardinality data.

7.32.4 common_role_of_object

A Common_role_of_object is a Common_association that indicates the Class_of_role the members of the object class may be assigned to.

EXPRESS specification:

```
*)
ENTITY common_role_of_object
   SUBTYPE OF (common_association);
   object : class;
   role   : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

object: The object specifies the Class whose members may be assigned to members of the Class_of_role.

The object role corresponds to role_1 of the common_association cardinality data.

role: The role specifies the Class_of_role that members of the object Class may be assigned to.

The role role corresponds to role_1 of the Common_association cardinality data.

7.32.5 common_temporal_sequence_of_activity

A Common_temporal_sequence_of_activity is a Common_association that is a specialization of Temporal_sequence_of_activity that constrain members of the predecessor class to happen before members of the successor class.

EXAMPLE The relationship between the Class_of_activity "specifying of process conditions" and the Class_of_activity "designing process plant" that indicates the specification shall precede design work is a Common_temporal_sequence_of_activity.

EXPRESS specification:

```
*)
ENTITY common_temporal_sequence_of_activity
   SUBTYPE OF (common_association);
   predecessor : class_of_activity;
   successor   : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Class_of_activity whose members happen before a member of the successor Class_of_activity.

The predecessor role corresponds to role_1 of the Common_association cardinality data.

successor: The successor specifies the Class_of_activity whose members happen after a member of the predecessor Class_of_activity.

The successor role corresponds to role_2 of the Common_association cardinality data.

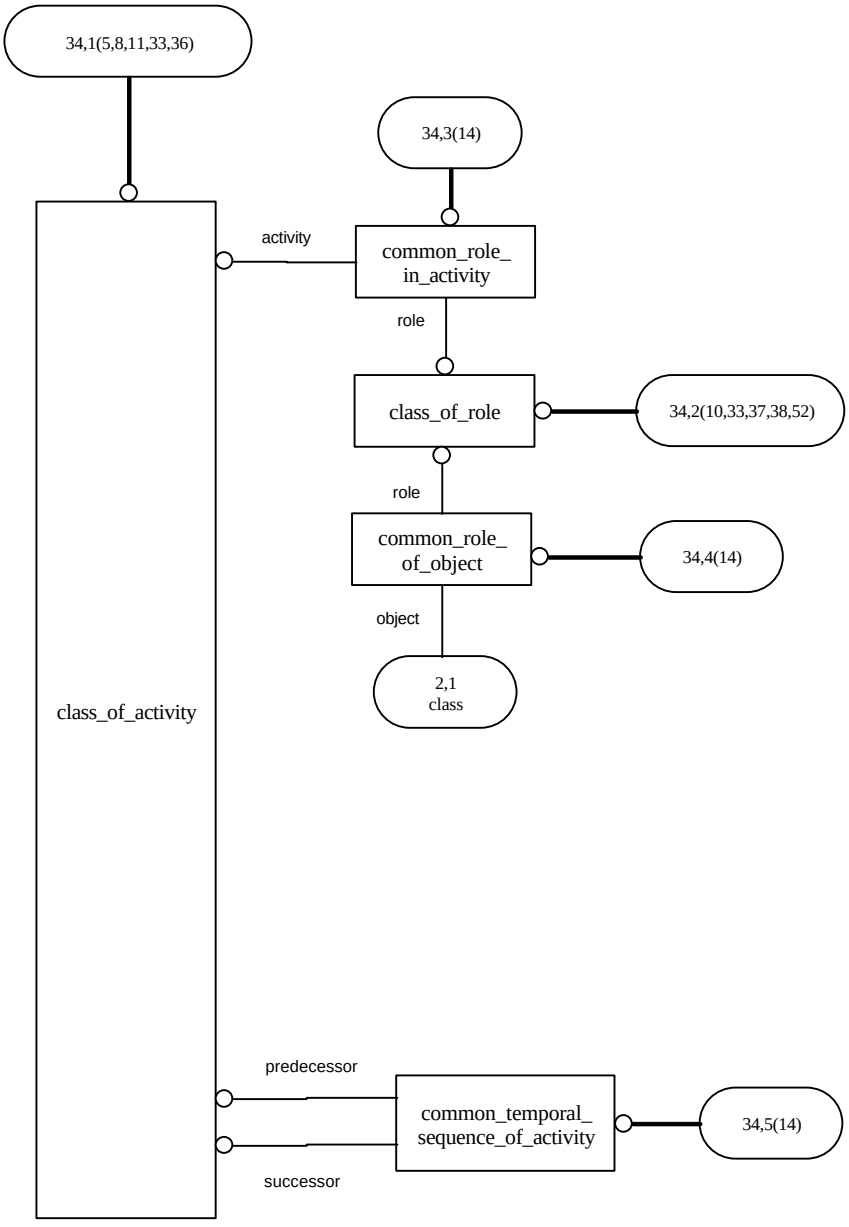


Figure 34 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of activity

7.33 Decomposition of activity

A description of the uses of the entity types shown in this section will go here, eventually.

7.33.1 composition_of_activity

A Composition_of_activity is a Composition_of_individual that indicates that the part Activity is part of the whole Activity.

A composition_of_activity may also be an Assembly_of_individual, where the whole is an Activity and a Single_individual, or a Collection_of_individual where the whole is an Activity and a Plural_individual.

EXAMPLE 1 The relationship between the activities "checking the plant process data" and "checking the process data of vessel V-4506" that indicates that checking the vessel data is a part of checking the plant data is a Composition_of_activity and an Assembly_of_individual.

EXAMPLE 2 The relationship between the Plural_individual that is a collection or set of Activities and Activity "A" that indicates "A" is included in the collection is a Composition_of_activity and a Collection_of_individual.

EXPRESS specification:

```
*)
ENTITY composition_of_activity
   SUBTYPE OF (composition_of_individual);
   SELF\composition_of_individual.part  : activity;
   SELF\composition_of_individual.whole : activity;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Activity that is part of the whole Activity.

whole: The whole specifies the Activity that is the whole for the part Activity.

7.33.2 composition_of_decomposition_aspect_of_activity

A Composition_of_decomposition_aspect_of_activity is a Composition_of_possessed_aspect that indicates a part Composition_of_activity relationship is a part of the whole Possessed_decomposition_aspect_of_activity.

EXAMPLE The relationship between the Composition_of_activity, that is between the Plant process data checking activity as the whole and the Vessel data checking activity as the part, and a Possessed_decomposition_aspect_of_activity that indicates the composition relationship is a part of the possessed decomposition aspect is a Composition_of_decomposition_aspect_of_activity.

EXPRESS specification:

```
*)
ENTITY composition_of_decomposition_aspect_of_activity
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part : composition_of_activity;
   SELF\composition_of_possessed_aspect.whole :
      possessed_decomposition_of_activity;
END_ENTITY;
(*
```

7.33.3 possessed_decomposition_of_activity

A Possessed_decomposition_aspect_of_activity is an Aspect_possessed_by_individual that is a collection of members of Composition_of_activity that defines a particular division of the possessor Activity into parts.

EXAMPLE Supposing that a plant revamp activity has the following parts: electrical works, mechanical works, works in Unit A, and works in Unit B. Then two Possessed_decomposition_aspect_of_activity may be defined for the Revamp Activity:

— engineering works consisting of the composition relationships between the plant revamp and the electrical and mechanical works, or

— Unit works consisting of the composition relationships between the revamp and unit A works and unit B works.

EXPRESS specification:

```
*)
ENTITY possessed_decomposition_of_activity
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : activity;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Activity that possesses the decomposition aspect.

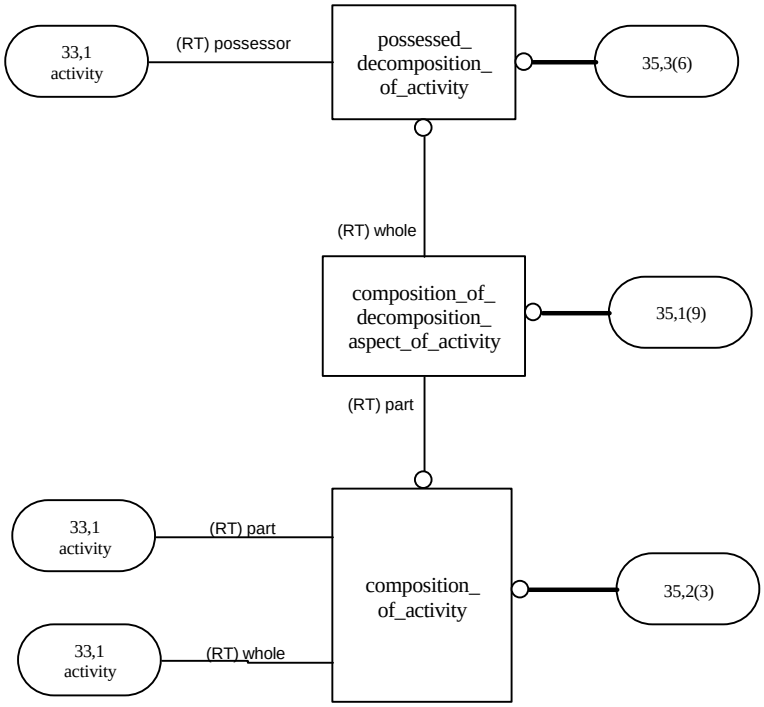


Figure 35 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Decomposition of activity

7.34 Common decomposition of activity

A description of the uses of the entity types shown in this section will go here, eventually.

7.34.1 common_composition_of_activity

A Common_composition_of_activity is a Common_composition_of_individual that is a specialization of Composition_of_activity that constrain members of the whole Class_of_activity to have members of the part Class_of_activity as parts.

EXAMPLE The class of relationships between the Class_of_activity "two shift operation" and the Class_of_activity "plant start up" that indicates a two shift operation must contain a start up activity is a Common_composition_of_activity.

The cardinality data are that a two shift operation must have one startup simultaneously and at least one throughout its life. Whereas a startup may be the start up of zero or one two shift operation.

EXPRESS specification:

```
*)
ENTITY common_composition_of_activity
   SUBTYPE OF (common_composition_of_individual);
   SELF\common_composition_of_individual.part : class_of_activity;
   SELF\common_composition_of_individual.whole : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Class_of_activity whose members are a part of members of the whole class.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Activity_class whose mebers can act as the whole for members of the part Class_of_activity.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.34.2 common_composition_of_decomposition_aspect_of_activity

A Common_composition_of_decomposition_aspect_of_activity is a Common_composition_of_aspect that indicates the type of Composition_of_activity relationships that are parts of the whole Common_decomposition_aspect_of_activity.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_composition_of_decomposition_aspect_of_activity
   SUBTYPE OF (common_composition_of_aspect);
   SELF\common_composition_of_aspect.part : common_composition_of_activity;
   SELF\common_composition_of_aspect.whole :
      common_decomposition_aspect_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Common_composition_of_activity whose members are parts of the members of the whole Common_decomposition_aspect_of_activity.

The part role corresponds to Role_1 of the Common_association cardinality data.

whole: The whole specifies the Common_decomposition_aspect_of_activity whose members are composed of members of the part Common_composition_of_activity.

The whole role corresponds to Role_2 of the Common_association cardinality data.

7.34.3 common_decomposition_aspect_of_activity

A Common_decomposition_aspect_of_activity is a Common_aspect that is a specialisation of Possessed_decomposition_aspect_of_activity whose members are possessed by members of the Class_of_activity and be composed of composition relationships restricted to be between members of the Class_of_activity indicated by the part Common_composition_of_activity.

EXAMPLE: ??

EXPRESS specification:

```
*)
ENTITY common_decomposition_aspect_of_activity
   SUBTYPE OF (common_aspect);
END_ENTITY;
(*
```

7.34.4 common_possession_of_decomposition_aspect_of_activity

A Common_possession_of_decomposition_aspect_of_activity is a Common_association that indicates that members of the possessor Class_of_activity possess members of the possessed Common_decomposition_aspect_of_activity.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_possession_of_decomposition_aspect_of_activity
   SUBTYPE OF (common_association);
   possessed : common_decomposition_aspect_of_activity;
   possessor : class_of_activity;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Class_of_activity whose members can be possessed by members of the possessor activity class.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class_of_activity whose members can possess members of the possessed common decomposition class.

The possessor role corresponds to role_2 of the Common_association cardinality data.

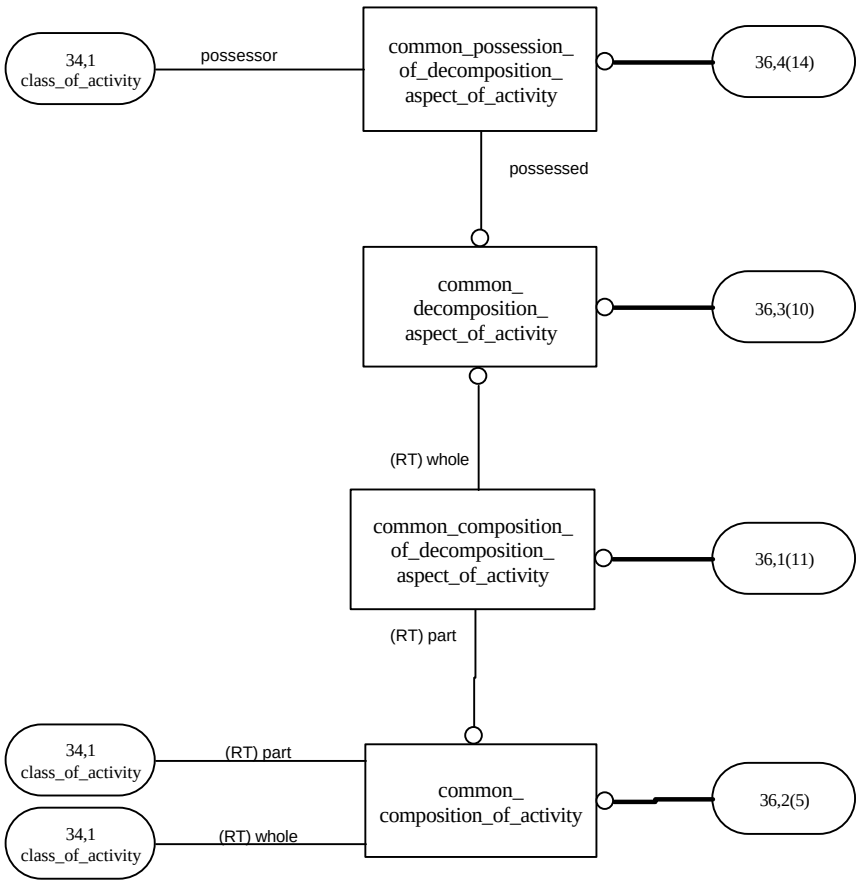


Figure 36 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common decomposition of activity

7.35 Physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.35.1 classification_of_physical_object_by_role

A Classification_of_physical_object_by_role is a Classification_of_individual that indicates the classified Physical_object is a member of the classifier Class_of_role.

EXAMPLE The relationship between the Materialized_physical_object "the catalyst material" and the Class_of_role "catalyst" that indicates the material is a catalyst is a Classification_of_physical_object_by_role.

It is not clear if this is a "designed to be" or "able to be" or "is".

EXPRESS specification:

```
*)
ENTITY classification_of_physical_object_by_role
   SUBTYPE OF (classification_of_individual);
   SELF\classification_of_individual.classified : physical_object;
   SELF\classification_of_individual.classifier : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Physical_object that is a member of the classifier Class_of_role.

classifier: The classifier specifies the Class_of_role that the classified Physical_object is a member of.

7.35.2 essential_classification_of_physical_object

An Essential_classification_of_physical_object is an Essential_classification_of_individual that indicates a common nature of Physical_object.

EXAMPLE The relationship between the Physical_object "P-1234" and the Class_of_physical_object "pump" that indicates P-1234 is a pump is an Essential_classification_of_physical_object.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_physical_object
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : physical_object;
   SELF\classification_of_individual.classifier : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Physical_object that is a member of the classifier Class_of_physical_object.

classifier: The classifier specifies the Class_of_physical_object that the classified Physical_object is a member of.

7.35.3 functional_part_of_physical_object

A Functional_part_of_physical_object is a Composition_of_physical_object that indicates the Functional_physical_object is a part of the whole Physical_object.

EXAMPLE The relationship between the pump with serial number 1234 and its impeller end bearing indicating that the impeller end bearing is a functional part of the pump is a Functional_part_of_physical_object.

EXPRESS specification:

```
*)
ENTITY functional_part_of_physical_object
   SUBTYPE OF (composition_of_physical_object);
   SELF\composition_of_physical_object.part : functional_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Functional_physical_object that is a part of the whole Physical_object.

7.35.4 functional_physical_object

A Functional_physical_object is a Physical_object that plays a particular role in an Activity.

A single Functional_physical_object can be different collections of molecules and atoms at different times. The aggregation of such collections being regarded as one as they perform the same role or function in an activity.

EXAMPLE The heat exchanger system known by tag E-4507 which is part of the distillate transfer system is a Functional_physical_object. Note this is distinct from the Materialized_physical_object "shell and tube heat exchanger manufacture # ES/1234" that was installed in the Tag when the plant was first built.

EXPRESS specification:

```
*)
ENTITY functional_physical_object
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.35.5 inanimate_physical_object

An Inanimate_physical_object is a Physical_object that is not capable of life.

EXAMPLE 1 A pump casing made from steel is an Inanimate_physical_object.

EXAMPLE 2 A fertile egg is not an Inanimate_physical_object.

EXAMPLE 3 A boiled egg is an Inanimate_physical_object.

EXPRESS specification:

```
*)
ENTITY inanimate_physical_object
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.35.6 installation_of_physical_object_for_functional_physical_object

An Installation_of_physical_object_for_functional_physical_object is a Possessed_association that indicates that the installed Physical_object is the Functional_physical_object for the duration of the installation.

EXAMPLE The relationship between the Functional_physical_object "Pump 1234 impeller end bearing" and the Materialized_physical_object "bearing with serial number abc5678", indicating the bearing is the impeller end bearing for the period of time 1998-11-21 to 1999-09-15 is an Installation_of_physical_object_for_functional_physical_object. The period of time of the installation is a Possessed_temporal_aspect, possessed by the installation association.

EXPRESS specification:

```
*)
ENTITY installation_of_physical_object_for_functional_physical_object
   SUBTYPE OF (possessed_association);
   functional : functional_physical_object;
   installed  : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

functional: The functional specifies the functional_physical_object that the installed Physical_object is assigned to be or used as.

installed: The installed specifies the Physical_object that is installed as the functional Functional_physical_object.

7.35.7 materialized_physical_object

A Materialized_physical_object is a Physical_object that is an identified configuration of matter or energy.

A Materialized_physical_object need not be the same matter through its life. Molecules or components may be gradually replaced without changing the identity.

EXAMPLE 1 The pump with serial number XYZ-3456 stamped on the casing is a Materialized_physical_object.

EXAMPLE 2 The pump of EXAMPLE 1 can be regarded as the same pump after the impeller has been replaced. However, replacing the casing and the impeller could be regarded as creating a new pump and destroying the old.

EXPRESS specification:

```
*)
ENTITY materialized_physical_object
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.35.8 physical_object

A Physical_object is an Individual that is a distribution of matter or energy in time and space.

A physical_object may be materialised or functional.

EXAMPLE:

EXPRESS specification:

```
*)
ENTITY physical_object
   ABSTRACT SUPERTYPE OF (ONEOF (inanimate_physical_object,
                                 lifeform,
                                 organization)
                    ANDOR ONEOF (materialized_physical_object,
                                 functional_physical_object)
                    ANDOR physical_feature)
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

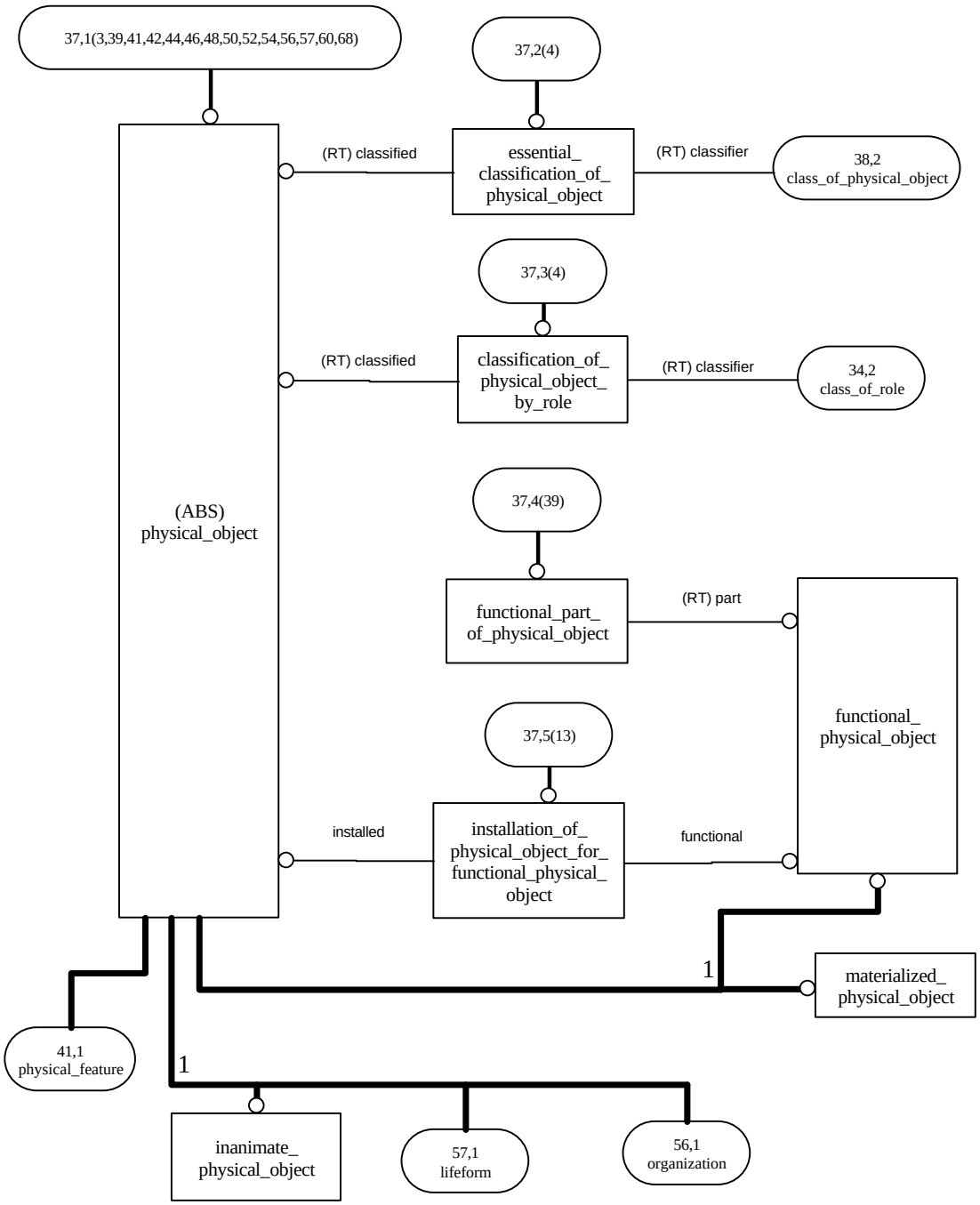


Figure 37 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Physical object

7.36 Class of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.36.1 class_of_inanimate_physical_object

A Class_of_inanimate_physical_object is a Class_of_physical_object that indicates a common nature of Inanimate_physical_object.

EXAMPLE 1 "Machine screw" is a Class_of_inanimate_physical_object.

EXAMPLE 2 "Boiler feedwater pump" is a Class_of_inanimate_physical_object.

EXPRESS specification:

```
*)
ENTITY class_of_inanimate_physical_object
   SUBTYPE OF (class_of_physical_object);
END_ENTITY;
(*
```

7.36.2 class_of_lifeform

A Class_of_lifeform is a Class_of_physical_object that indicates a common nature of Lifeforms.

EXAMPLE "Live yeast" is a Class_of_lifeform.

EXPRESS specification:

```
*)
ENTITY class_of_lifeform
   SUBTYPE OF (class_of_physical_object);
END_ENTITY;
(*
```

7.36.3 class_of_organization

A Class_of_organization is a Class_of_physical_object that indicates a common nature of Organisation.

EXAMPLE A Limited Company registered in England and Wales is a Class_of_organization.

EXPRESS specification:

```
*)
ENTITY class_of_organization
   SUBTYPE OF (class_of_physical_object);
END_ENTITY;
(*
```

7.36.4 class_of_person

A Class_of_person is a Class_of_physical_object that indicates a common nature of Persons.

EXAMPLE Instrumentation engineer is a Class_of_person.

EXPRESS specification:

```
*)
ENTITY class_of_person
   SUBTYPE OF (class_of_lifeform);
END_ENTITY;
(*
```

7.36.5 class_of_physical_object

A Class_of_physical_object is a Class_of_individual that indicates a common nature of Physical_object.

EXAMPLE Pump, a physical object that can be used as the performer of pumping activities, is a Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY class_of_physical_object
   SUPERTYPE OF (ONEOF (class_of_inanimate_physical_object,
                        class_of_organization,
                        class_of_lifeform)
          ANDOR class_of_physical_feature)
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.36.6 common_functional_part_of_physical_object

A Common_functional_part_of_physical_object is a Common_composition_of_physical_object that is a specialization of Functional_part_of_physical_object, indicating a class_of_role the members of the installed Class_of_physical_object may be assigned as or used for.

EXAMPLE The class of relationships between the Class_of_role "impeller end bearing" and the Class_of_physical_object "impeller pump" that indicates an impeller pump has an impeller end bearing is a Common_functional_part_of_physical_object.

The cardinality constraints of this should indicate that an impeller pump has one and only one impeller end bearing throughout its life, and that an impeller end bearing is a part of one and only one pump throughout its life.

EXPRESS specification:

```
*)
ENTITY common_functional_part_of_physical_object
   SUBTYPE OF (common_composition_of_physical_object);
   SELF\common_composition_of_physical_object.part : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Class_of_role whose members are parts of members of the whole Class_of_physical_object.

The part role corresponds to role_1 of the Common_association cardinality data.

7.36.7 common_installation_of_physical_object_for_functional_physical_object

A Common_installation_of_physical_object_for_functional_physical_object is a Common_association that is a specialization of Installation_of_physical_object that indicates a member of the installed Class_of_physical_object is installed as a member of the functional Class_of_role.

Please note that this definition implies Class_of_role is a specialization of Class_of_physical object (the missing class_of_functional_physical_object), which in the model it is not. There is an EXPRESS error to this effect.

EXAMPLE The class of relationship between the Class_of_physical_object "Bloggs type 2b pump" and the Class_of_role "boiler feedwater pump" that indicates that a 2b pump can be installed as a boiler feedwater pump is a Common_installation_of_physical_object_for_functional_object.

The cardinality constraints should indicate that a Bloggs pump has zero or one installations of as a boiler pump at a point in time and any number throughout its life, and a feedwater pump may have zero or one Bloggs pumps installed at a point in time and any number over time.

EXPRESS specification:

```
*)
ENTITY common_installation_of_physical_object_for_functional_physical_object
   SUBTYPE OF (common_association);
   functional : class_of_role;
   installed  : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

functional: The functional specifies the Class_of_role that members of the Class_of_physical_object may be installed for.

The functional role corresponds to role_1 of the Common_association cardinality data.

installed: The installed specifies the Class_of_physical_object whose members may be installed as members of the functional Class_of_role.

The installed role corresponds to role_2 of the Common_association cardinality data.

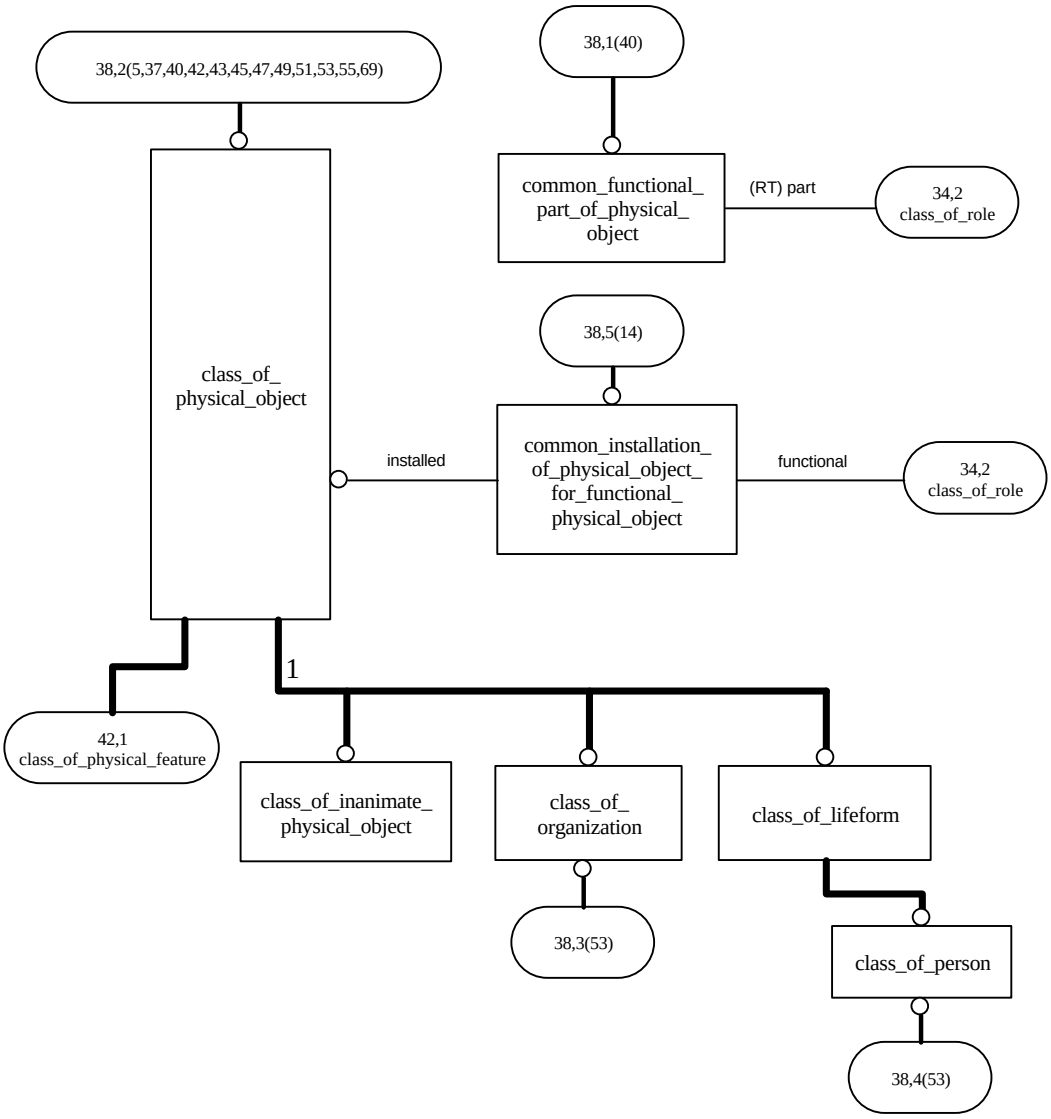


Figure 38 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of physical object

7.37 Decomposition of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.37.1 composition_of_decomposition_aspect_of_physical_object

The Composition_of_decomposition_aspect_of_physical_object is a Composition_of_possessed_aspect that indicates the part Composition_of_physical_object is a part of the whole Possessed_decomposition_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY composition_of_decomposition_aspect_of_physical_object
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part : composition_of_physical_object;
   SELF\composition_of_possessed_aspect.whole :
      possessed_decomposition_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Composition_of_physical_object that is part of the whole Possessed_decomposition_aspect_of_physical_object.

whole: The whole specifies the Possessed_decomposition_aspect_of_physical_object that is the whole of the part Composition_of_physical_object.

7.37.2 composition_of_physical_object

A Composition_of_physical_object is a Composition_of_individual that indicates the part physical_object is part of the whole physical_object.

A Composition_of_physical_object can be an Assembly_of_individual or a Collection_of_individual where the whole is a Single_individual or a Plural_individual respectively.

EXAMPLE 1 The relationship between the Materialized_physical_object "impeller pump P-1234" and the Materialized_physical_object "impeller I-5667" that indicates the impeller is an actual part of the pump is a Composition_of_physical_object, an Assembly_of_individual, and a Possessed_actual_aspect.

EXAMPLE 2 The relationship between the Materialized_physical_object "impeller pump P-1234" and the Materialized_physical_object "stock of 25 impeller pumps held by the XYZ OpCo" that indicates P-1234 is a part of the stock is a Composition_of_physical_object, a Collection_of_individual, and a Possessed_actual_aspect.

EXAMPLE 3 The relationship between the functional_physical_object "CDU steam system" and the functional_physical_object "boiler feedwater pump 2" that indicates pump 2 is part of the steam system is a Composition_of_physical_object, an Assembly of individual, and a Possessed_actual_aspect.

EXAMPLE 4 The relationship between the Materialized_physical_object "impeller pump P-1234" and its impeller end bearing indicating that the impeller end bearing is a functional part of the pump is a Functional_part_of_physical_object, an Assembly of individual, and a Possessed_actual_aspect.

EXPRESS specification:

```
*)
ENTITY composition_of_physical_object
   SUBTYPE OF (composition_of_individual);
   SELF\composition_of_individual.part  : physical_object;
   SELF\composition_of_individual.whole : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Physical_object that is part of the whole Physical_object.

whole: The whole specifies the Physical_object that is the whole for the part Physical_object.

7.37.3 possessed_decomposition_aspect_of_physical_object

A Possessed_decomposition_aspect_of_physical_object is an Aspect_possessed_by_individual that is a composition of Composition_of_physical_object. A decompositional aspect defines a particular decomposition of interest by indicating the composition relationships that define the decomposition.

EXAMPLE The decomposition that is defined by the composition relationships [A,B], [A,C], [B,D], [B,E] is a Possessed_decomposition_aspect_of_physical_object that is possessed by by A.

EXPRESS specification:

```
*)
ENTITY possessed_decomposition_aspect_of_physical_object
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Physical_object that possesses the decomposition aspect.

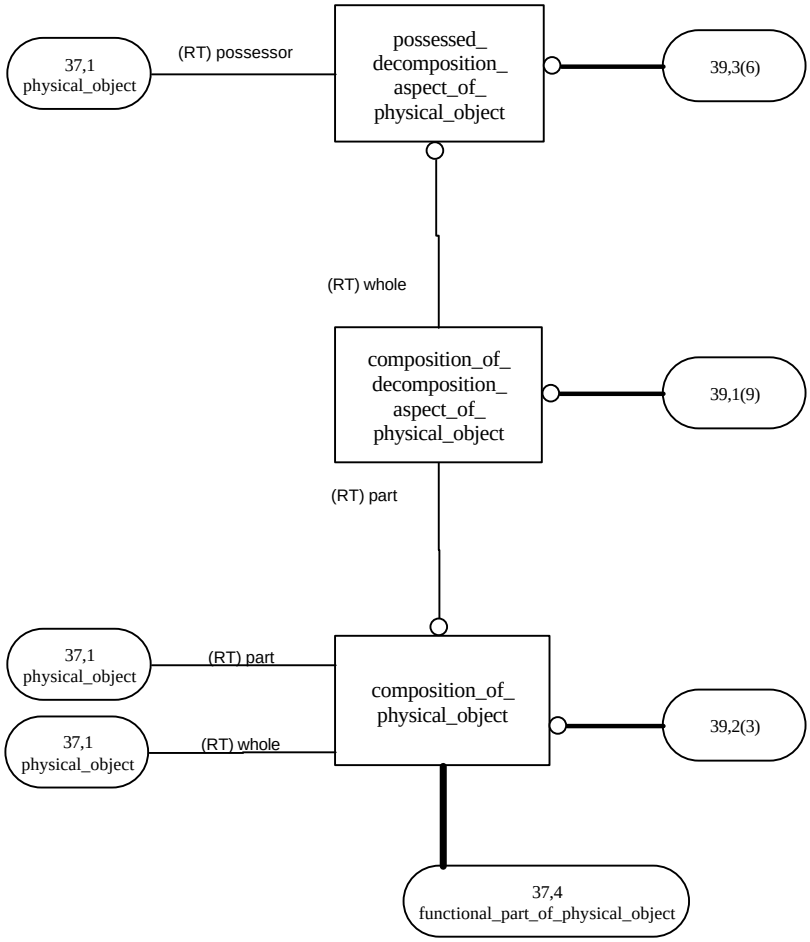


Figure 39 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Decomposition of physical object

7.38 Common decomposition of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.38.1 common_composition_of_decomposition_aspect_of_physical_object

A Common_composition_of_decomposition_aspect_of_physical_object is a Common_composition_of_aspect that is a specialization of Composition_of_decomposition_aspect_of_physical_object, constraining the types of Physical_object than can be parts of members of the whole Common_decomposition_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_composition_of_decomposition_aspect_of_physical_object
   SUBTYPE OF (common_composition_of_aspect);
   SELF\common_composition_of_aspect.part : common_composition_of_physical_object;
   SELF\common_composition_of_aspect.whole :
      common_decomposition_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Common_composition_of_physical_object whose members are parts of members of the whole Common_decomposition_aspect_of_physical_object.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Common_decomposition_aspect_of_physical_object whose members are the whole for members of the part Common_composition_of_physical_object.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.38.2 common_composition_of_physical_object

A Common_composition_of_physical_object is a Common_composition_of_individual that is a specialization of Composition_of_physical_object where members of the part Class_of_Physical_object are constrained to be parts of members of the whole Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "impeller pump" and the Class_of_physical_object "impeller" that indicates impeller pumps have an impeller as a part is a Common_composition_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_composition_of_physical_object
   SUBTYPE OF (common_composition_of_individual);
   SELF\common_composition_of_individual.part  : class_of_physical_object;
   SELF\common_composition_of_individual.whole : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Class_of_physical_object whose members can be parts of the members of the whole Class_of_physical_object.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Class_of_physical_object whose members can be wholes for the members of the part Class_of_physical_object.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.38.3 common_decomposition_aspect_of_physical_object

A Common_decomposition_aspect_of_physical_object is a Common_aspect that is a specialization of Possessed_decomposition_aspect_of_physical_object, constraining the types of Physical_object that are parts of members of the Common_decomposition_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_decomposition_aspect_of_physical_object
   SUBTYPE OF (common_aspect);
END_ENTITY;
(*
```

7.38.4 common_possession_of_decomposition_aspect_by_physical_object

A Common_possession_of_decomposition_aspect_by_physical_object is a Common_association that indicates that members of the possessor Class_of_physical_object possess members of the possessed Common_decomposition_aspect_of_physical_object class.

EXPRESS specification:

```
*)
ENTITY common_possession_of_decomposition_aspect_by_physical_object
   SUBTYPE OF (common_association);
   possessed : common_decomposition_aspect_of_physical_object;
   possessor : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Common_decomposition_aspect_of_physical_object whose members can be possessed by members of the possesser class.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class_of_physical_object whose members may possess members of the possessed Common_decomposition_aspect_of_physical_object.

The possessor role corresponds to role_2 of the Common_association cardinality data.

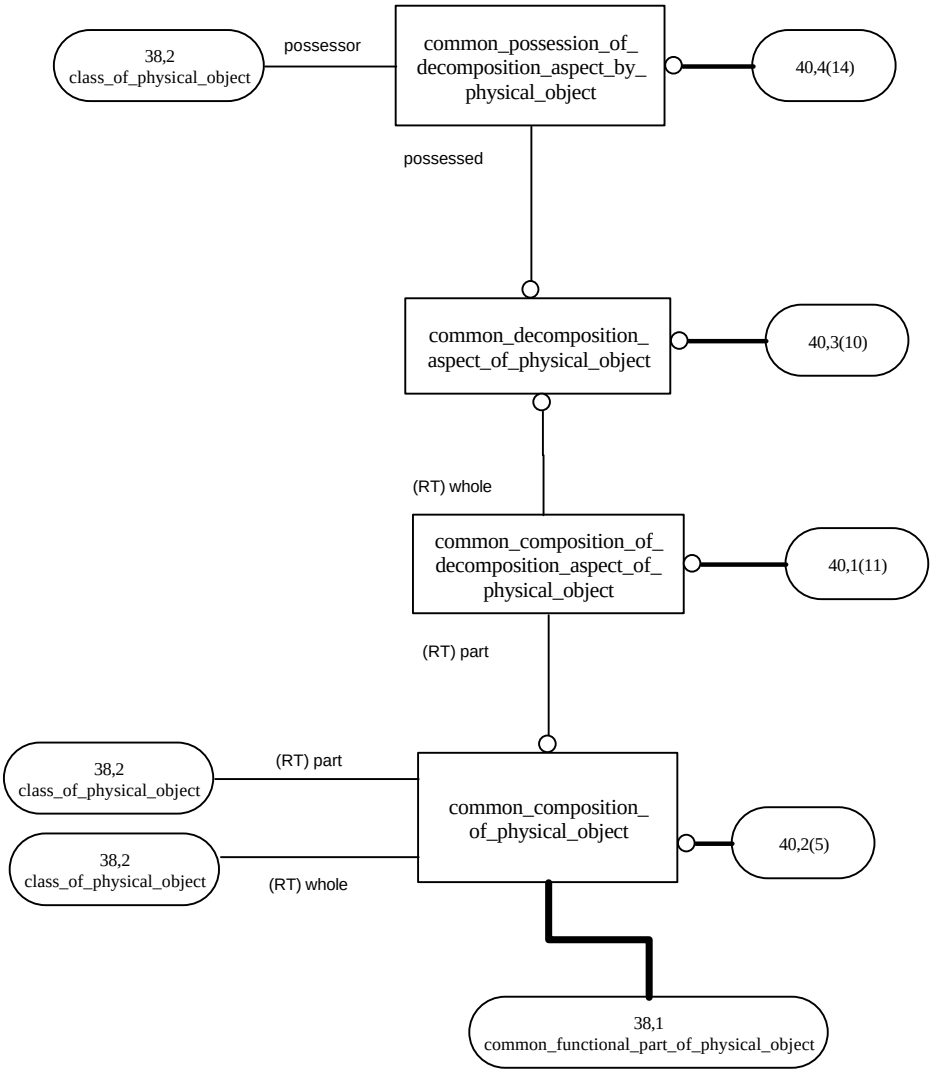

38,2
class_of_physical_object
possessor
common_possession_of_
decomposition_aspect_by_
physical_object
40,4(14)
possessed
common_decomposition_
aspect_of_physical_object
40,3(10)
(RT) whole
common_composition_of_
decomposition_aspect_of_
physical_object
40,1(11)
(RT) part
38,2
class_of_physical_object
(RT) part
common_composition_
of_physical_object
40,2(5)
38,2
class_of_physical_object
(RT) whole
38,1
common_functional_part_of_physical_object

Figure 40 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common decomposition of physical object

7.39 Connection of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.39.1 connection_of_physical_object

A Connection_of_physical_object is a Possessed_association that indicates either a physical or a logical connection.

A physical connection exists if the matter of the two connected Physical_objects are in direct contact or the regions of space occupied by the two connected objects touch or intersect.

A logical connection exists if the connected Physical_objects are able to affect each other by the transfer of energy, matter, or force.

There is no significance to the role of connected_1 compared to connected_2.

EXAMPLE 1 The relationship between the keyboard of my computer and the processor unit of my computer that indicates that they are connected is a Connection_of_physical_object.

EXAMPLE 2 The relationship between two people having a conversation is a Connection_of_physical_object.

EXAMPLE 3 The relationship between a road tyre and the road it stands on is a Connection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY connection_of_physical_object
   SUPERTYPE OF (ONEOF (physical_connection_of_physical_object,
                        logical_connection_of_physical_object))
   SUBTYPE OF (possessed_association);
   connected_1 : physical_object;
   connected_2 : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connected_1: The connected_1 specifies the Physical_object that is connected to the connected_2 Physical_object.

connected_2: The connected_2 specifies the Physical_object that is connected to the connected_1 Physical_object.

7.39.2 connector_of_physical_object

A Connector_of_physical_object is a Possessed_association that indicates the connector Physical_object is a part of the whole Physical_object that enables connections to be made to the whole.

EXAMPLE The relationship between Nozzle 1 of reflux vessel V-4506 and the reflux vessel V-4506 that indicates the nozzle is used to make a connection with the vessel is a Connector_of_physical_object.

EXPRESS specification:

```
*)
ENTITY connector_of_physical_object
   SUBTYPE OF (possessed_association);
   connector : physical_object;
   whole     : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connector: The connector specifies the part of the whole Physical_object that enables connections with the whole.

whole: The whole specifies the Physical_object that the connector part enables connections with.

7.39.3 logical_connection_of_physical_object

A Logical_connection_of_physical_object is a Possessed_association that indicates a logical connection between the connected Physical_objects

A logical connection exists if the connected Physical_objects are able to affect each other by the transfer of energy, matter, or force.

There is no significance to the role of connected_1 compared to connected_2.

EXAMPLE The relationship between the Physical_object "reformate unit B" and the Physical_object "distillation tower 6" that indicates distillate from the tower can be fed to the reformate unit is a Logical_connection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY logical_connection_of_physical_object
   SUBTYPE OF (connection_of_physical_object);
END_ENTITY;
(*
```

7.39.4 physical_connection_of_physical_object

A Physical_connection_of_physical_object is a Possessed_association that indicates a physical connection.

A physical connection exists if the matter of the two connected Physical_objects are in direct contact or the regions of space occupied by the two connected objects touch or intersect.

There is no significance to the role of connected_1 compared to connected_2.

EXAMPLE The relationship between a plug and a socket indicating the plug and socket are in contact is a physical_connection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY physical_connection_of_physical_object
   SUBTYPE OF (connection_of_physical_object);
END_ENTITY;
(*
```

7.39.5 physical_feature

A Physical_feature is a Physical_object that is a separable part, but whose boundaries are only completely determined by the separation process.

EXAMPLE A pipe end is a Physical_feature.

EXPRESS specification:

```
*)
ENTITY physical_feature
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.39.6 physical_feature_of_physical_object

A Physical_feature_of_physical_object is a Possessed_association that indicates the feature Physical_object is a separable but not separated part of the whole Physical_object.

EXAMPLE The relationship between a pipe and its threaded end indicating the threaded end is an unseparated part of the pipe is a Physical_feature_of_physical_object.

EXPRESS specification:

```
*)
ENTITY physical_feature_of_physical_object
   SUBTYPE OF (possessed_association);
   feature : physical_feature;
   whole   : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

feature: The feature specifies the Physical_object that is a feature of the whole Physical_object.

whole: The whole specifies the Physical_object that the feature Physical_object is a feature of.

7.39.7 usage_of_physical_feature_in_connection

A Usage_of_physical_feature_in_connection is a Usage_of_physical_object_in_connection where the used physical_object is a Physical_feature.

EXAMPLE The relationship between the Connection_of_physical_object that is the connection of a pipe and a vessel, and the vessel nozzle flange, indicating the nozzle flange is participating in the connection is a Usage_of_physical_feature_in_connection.

EXPRESS specification:

```
*)
ENTITY usage_of_physical_feature_in_connection
   SUBTYPE OF (usage_of_physical_object_in_connection);
   SELF\usage_of_physical_object_in_connection.used : physical_feature;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Physical_feature used to make the using connection.

7.39.8 usage_of_physical_object_in_connection

A Usage_of_physical_object_in_connection is a Possessed_association that indicates the used Physical_object is participating in the connection.

EXAMPLE The relationship between the connection of the flanged ends of two pipes and the bolts, nuts, washers and gasket set that is a Physical_object and a Plural_individual that indicates the bolt & gasket set is participating in the connection is a Usage_of_physical_object_in_connection.

EXPRESS specification:

```
*)
ENTITY usage_of_physical_object_in_connection
   SUBTYPE OF (possessed_association);
   used  : physical_object;
   using : connection_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Physical_object that participate in the connection.

using: The using specifies the connection that the used Physical_object participates in.

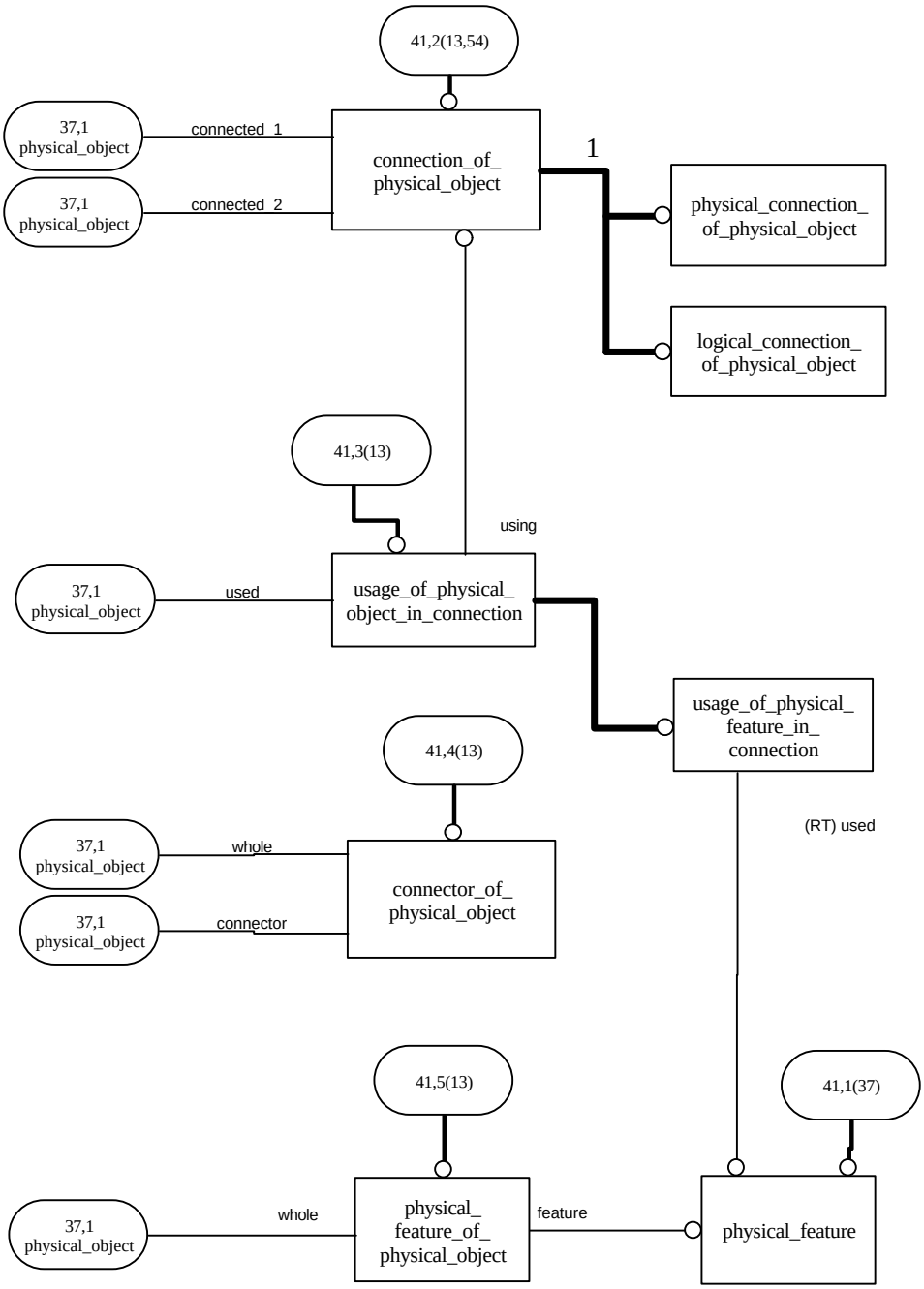


Figure 41 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Connection of physical object

7.40 Common connection of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.40.1 class_of_physical_feature

A Class_of_physical_feature is a Class_of_physical_object that is a specialization of Physical_feature indicating a common nature of Physical_feature.

EXAMPLE 1 Face, including the surface material, shape and finish, is a Class_of_physical_feature.

EXAMPLE 2 Threaded end is a Class_of_physical_feature.

EXAMPLE 3 A hole, including some material surrounding a space containing no solid material is a Class_of_physical_feature.

EXPRESS specification:

```
*)
ENTITY class_of_physical_feature
   SUBTYPE OF (class_of_physical_object);
END_ENTITY;
(*
```

7.40.2 common_connection_of_physical_object

A Common_connection_of_physical_object is a Common_association that is a specialization of Connection_of_physical_object that constrains the members of the connected_1 Class_of_physical_object to have connections with members of the Connected_2 Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_connection_of_physical_object
   SUPERTYPE OF (ONEOF (common_logical_connection_of_physical_object,
                        common_physical_connection_of_physical_object))
   SUBTYPE OF (common_association);
   connected_1 : class_of_physical_object;
   connected_2 : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connected_1: The connected_1 specifies the Class_of_physical_object whose members are connected to members of the connected_2 Class_of_physical_object.

The connected_1 role corresponds to role_1 of the Common_association cardinality data.

connected_2: The connected_2 specifies the Class_of_physical_object whose members are connected to members of the connected_1 Class_of_physical_object.

The connected_2 role corresponds to role_2 of the Common_association cardinality data.

7.40.3 common_connector_of_physical_object

A Common_connector_of_physical_object is a Common_association that is a specialization of Connector_of_physical_object that constrains the members of the whole Class_of_physical_object to have members of the connector Class_of_physical_object as connectors.

EXAMPLE The class of relationship between the Class_of_physical_object "vessel" and the class_of_physical_object "nozzle" that indicates that vessels can have any number of nozzles as connectors is a Common_connection_of_physical_object.

The cardinality of the whole is 0 to many simultaneously and over time, and the cardinality of the connector is zero to one, simultaneously and zero to many over time.

EXPRESS specification:

```
*)
ENTITY common_connector_of_physical_object
   SUBTYPE OF (common_association);
   connector : class_of_physical_object;
   whole     : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connector: The connector specifies the Class_of_physical_object whose members are connector parts of members of the whole Class_of_physical_object.

The connector role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Class_of_physical_object whose members can have members of the connector Class_of_physical_object as connector parts .

The whole role corresponds to role_2 of the Common_association cardinality data.

7.40.4 common_logical_connection_of_physical_object

A Common_logical_connection_of_physical_object is a Common_connection_of_physical_object that is specialization of Logical _connection_of_physical_object that constrains the members of the connected_1 Class_of_physical_object to have logical connections with members of the Connected_2 Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "reactor vessel" and the Class_of_physical_object "temperature sensor" that indicates that a reactor vessel is logically connected to any number of temperature sensors simultaneously and over time, is a Common_logical_connection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_logical_connection_of_physical_object
   SUBTYPE OF (common_connection_of_physical_object);
END_ENTITY;
(*
```

7.40.5 common_physical_connection_of_physical_object

A Common_physical_connection_of_physical_object is a Common_connection_of_physical_object that is specialization of Physical _connection_of_physical_object that constrains the members of the connected_1 Class_of_physical_object to have physical connections with members of the Connected_2 Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "foundation type A" and the Class_of_physical_object "XYZ Co Pump Type 2a" that indicates that 2a pumps can be bolted to a foundation of type A is a Common_physical_connection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_physical_connection_of_physical_object
   SUBTYPE OF (common_connection_of_physical_object);
END_ENTITY;
(*
```

7.40.6 common_physical_feature_of_physical_object

A Common_physical_feature_of_physical_object is a Common_association that is a specialization of Physical_feature_of_physical_object that constrains the members of the whole Class_of_physical_object to have features that are members of the feature Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "flanged pipe" and the class_of_physical_feature "flanged end" that indicates a pipe must have one or more flanged ends is Common_physical_feature_of_physical_object.

The cardinality of whole is set to a lower limit of 1 and an upper limit of many both simultaneously and over time. The cardinality of a feature member is set to zero to one, simultaneously and zero to many over time.

EXPRESS specification:

```
*)
ENTITY common_physical_feature_of_physical_object
   SUBTYPE OF (common_association);
   feature : class_of_physical_feature;
   whole   : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

feature: The feature specifies the Class_of_physical feature whose members may be possessed by members of the whole Class_of_physical_object.

The feature corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Class_of_physical_object whose members may possessed members of the feature Class_of_physical_feature.

The whole corresponds to role_2 of the Common_association cardinality data.

7.40.7 common_usage_of_physical_feature_in_connection

A Common_usage_of_physical_feature_in_connection is a Common_association that is a specialization of Usage_of_physical_feature_in_connection that constrains the members of the using connection relationships to use members of the Class_of_physical_feature for the connection.

EXAMPLE The class of relationship between the Common_connection_of_physical_object that indicates that B12 type beams are connected to pipe hangers, and the Class_of_physical_feature "20mm Dia hole", that indicates that four 20mm dia holes are used in the connection of a pipehanger to a type B12 beam is a Common_usage_of_physical_feature_in_connection.

The cardinality of the using is four to four simultaneously and over time. The cardinality of the used is zero to one, simultaneously, and zero to many over time.

EXPRESS specification:

```
*)
ENTITY common_usage_of_physical_feature_in_connection
   SUBTYPE OF (common_usage_of_physical_object_in_connection);
   SELF\common_usage_of_physical_object_in_connection.used :
      class_of_physical_feature;
END_ENTITY;
(*
```

7.40.8 common_usage_of_physical_object_in_connection

A Common_usage_of_physical_object_in_connection is a Common_association that is a specialization of Usage_of_physical_object_in_connection that constrains the members of the using connection relationships to use members of the Class_of_physical_object for the connection.

EXAMPLE The class of relationship between the Common_connection_of_physical_object that indicates that B12 type beams are connected to pipe hangers, and the Class_of_physical_object "20mm Dia bolt", that indicates that four 20mm dia bolts are used in the connection of a pipehanger to a type B12 beam is a Common_usage_of_physical_object_in_connection.

The cardinality of the using is four to four simultaneously and over time. The cardinality of the used is zero to one, simultaneously, and zero to many over time.

EXPRESS specification:

```
*)
ENTITY common_usage_of_physical_object_in_connection
   SUBTYPE OF (common_association);
   used  : class_of_physical_object;
   using : common_connection_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Class_of_physical_object whose members may be used by the members of the using connection class.

The used role corresponds to role_1 in the Common_association cardinality data.

using: The using specifies the Common_connection_of_physical_object whose members may use members of the used Class_of_physical_object to make the connection.

The using role corresponds to role_2 in the Common_association cardinality data.

7.40.9 connection_of_physical_object_with_member_of_class_of_physical_object

A Connection_of_physical_object_with_member_of_class_of_physical_object is a Common_association that is a specialization of Connection_of_physical_object that constrains the connected_1 Physical_object to be connected with members of the connected_2 Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY connection_of_physical_object_with_member_of_class_of_physical_object
   SUPERTYPE OF (ONEOF (logical_connection_of_physical_object_with_member_of_class,
                        physical_connection_of_physical_object_with_member_of_class))
   SUBTYPE OF (common_association);
   connected_1 : physical_object;
   connected_2 : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connected_1: The connected_1 specifies the Physical_object that is connected to members of the Class_of_physical_object.

The connected_1 role corresponds to role_1 of the Common_association cardinality data.

connected_2: The connected_2 specifies the Class_of_physical_object whose members can be connected to the connected_1 Physical_object.

The connected_2 role corresponds to the role_2 of the Common_association cardinality data.

7.40.10 logical_connection_of_physical_object_with_member_of_class

A Logical_connection_of_physical_object_with_member_of_class is a Common_connection_of_physical_object that is specialization of Logical _connection_of_physical_object that constrains the connected_1 Physical_object to be connected with members of the Connected_2 Class_of_physical_object.

EXAMPLE The class of relationship between the Physical_object "reactor vessel R-0001" and the Class_of_physical_object "temperature sensor" that indicates the reactor vessel is logically connected to any number of temperature sensors simultaneously and over time, is a Logical_connection_of_physical_object_with_member_of_class.

EXPRESS specification:

```
*)
ENTITY logical_connection_of_physical_object_with_member_of_class
   SUBTYPE OF
   (connection_of_physical_object_with_member_of_class_of_physical_object);
END_ENTITY;
(*
```

7.40.11 physical_connection_of_physical_object_with_member_of_class

A Physical_connection_of_physical_object_with_member_of_class is a Common_connection_of_physical_object that is specialization of Physical _connection_of_physical_object that restricts the connected_1 Physical_object to be connected with members of the Connected_2 Class_of_physical_object.

EXAMPLE The class of relationship between the Physical_object "foundation 7" and the Class_of_physical_object "XYZ Co Pump Type 2a" that indicates that 2a pumps can be bolted to the foundation is a Physical_connection_of_physical_object_with_member_of_class.

EXPRESS specification:

```
*)
ENTITY physical_connection_of_physical_object_with_member_of_class
   SUBTYPE OF
   (connection_of_physical_object_with_member_of_class_of_physical_object);
END_ENTITY;
(*
```

7.40.12 possession_of_member_of_class_of_physical_feature

A Possession_of_member_of_class_of_physical_feature is a Common_association that is a specialization of Physical_feature_of_physical_object
that constrains the whole Physical_object to have features that are members of the feature Class_of_physical_object.

EXAMPLE The class of relationship between the Physical_object "Beam B-1234" and the Class_of_physical_feature "20mm diameter bolt hole" that indicates the beam has four such bolt holes is a Possession_of_member_of_class_of_physical_feature.

The cardinality of whole is set to a lower limit of 4 and an upper limit of 4 simultaneously and for all time. The cardinality of feature members is set to 0 and 1, simultaneoulsy and through time.

EXPRESS specification:

```
*)
ENTITY possession_of_member_of_class_of_physical_feature
   SUBTYPE OF (common_association);
   feature : class_of_physical_feature;
   whole   : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

feature: The feature specifies the Class_of_physical_feature whose members may be possessed by the whole Physical_object.

The feature role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Physical_object that can have members of the feature class as features.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.40.13 possession_of_member_of_class_of_physical_object_as_connector

A Possession_of_member_of_class_of_physical_object_as_connector is a Common_association that is a specialization of Connector_of_physical_object that constrains the whole Physical_object to have members of the connector Class_of_physical_object as connector parts.

EXAMPLE The class of relationship between the Physical_object "Pipeline C12" and the Class_of_physical_object "olet" that indicates the pipeline has several olet connectors is a Possession_of_member_of_class_of_physical_object_as_connector.

The cardinality of the whole is 1 to many simultaneously and over time, and the cardinality of the connector is zero to one, simultaneoulsy and zero to many over time.

EXPRESS specification:

```
*)
ENTITY possession_of_member_of_class_of_physical_object_as_connector
   SUBTYPE OF (common_association);
   connector : class_of_physical_object;
   whole     : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

connector: The connector specifies the Class_of_physical_object whose members may be connector parts of the whole Physical_object.

The connector role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Physical_object that has members of the connector Class_of_physical_object as connector parts.

The whole role corresponds to Role_2 of the Common_association cardinality data.

7.40.14 usage_of_member_of_class_of_physical_feature_in_connection

A Usage_of_member_of_class_of_physical_feature_in_connection is a Common_association that is a specialization of Usage_of_physical_feature_in_connection that constrains members of the using connection relationships to use members of the Class_of_physical_feature for the connection.

EXAMPLE The class of relationship between the Common_connection_of_physical_object_with_member_of_class_of_physical_object that indicates the beam B12 is connected to some pipe hangers and the Class_of_Physical_object 20mm Dia holes that indicates that four 20mm dia holes are used in the connection of a pipehanger to the beam is a Usage_of_member_of_class_of_physical_feature_in_connection.

EXPRESS specification:

```
*)
ENTITY usage_of_member_of_class_of_physical_feature_in_connection
   SUBTYPE OF (usage_of_member_of_class_of_physical_object_in_connection);
   SELF\usage_of_member_of_class_of_physical_object_in_connection.used :
      class_of_physical_feature;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Class_of_physical_feature whose members may particpate in the members of the using connection class.

The used role corresponds to role_1 in the common_association cardinality data.

7.40.15 usage_of_member_of_class_of_physical_object_in_connection

A Usage_of_member_of_class_of_physical_object_in_connection is a Common_association that is a specialization of Usage_of_physical_object_in_connection that constrains members of the using connection relationships to use members of the Class_of_physical_object for the connection.

EXAMPLE The class of relationship between the common_connection_of_physical_object_with_member_of_class_of_physical_object that indicates beam B12 is connected to some pipe hangers, and the Class_of_Physical_object "20mm Dia bolts", that indicates that four 20mm dia bolts are used in the connection of a pipehanger to the beam is a Usage_of_member_of_class_of_physical_object_in_connection.

The cardinality of the using is four to four simultaneously and over time, and the cardinality of the used is zero to one, simultaneoulsy and zero to many over time.

EXPRESS specification:

```
*)
ENTITY usage_of_member_of_class_of_physical_object_in_connection
   SUBTYPE OF (common_association);
   used  : class_of_physical_object;
   using : connection_of_physical_object_with_member_of_class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Class_of_physical_object whose members may be used by the members of the using connection class.

The used role corresponds to role_1 in the Common_association cardinality data.

using: The using specifies the Connection_of_physical_object_with_member_of_physical_object_class whose members may use members of the used Class_of_physical_object to make the connection.

The using role corresponds to role_2 in the Common_association cardinality data.

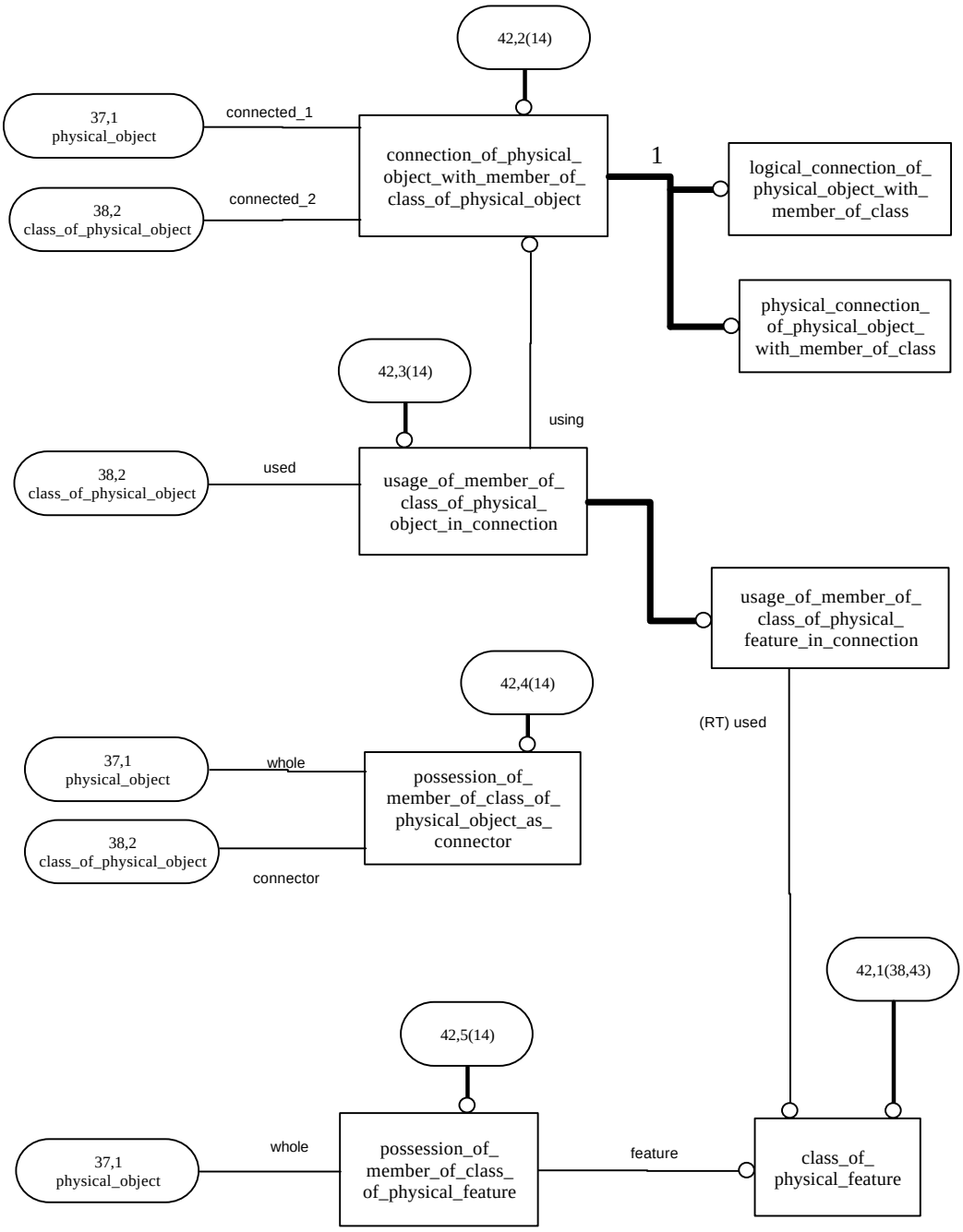


Figure 42 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common connection of physical object (1 of 2)

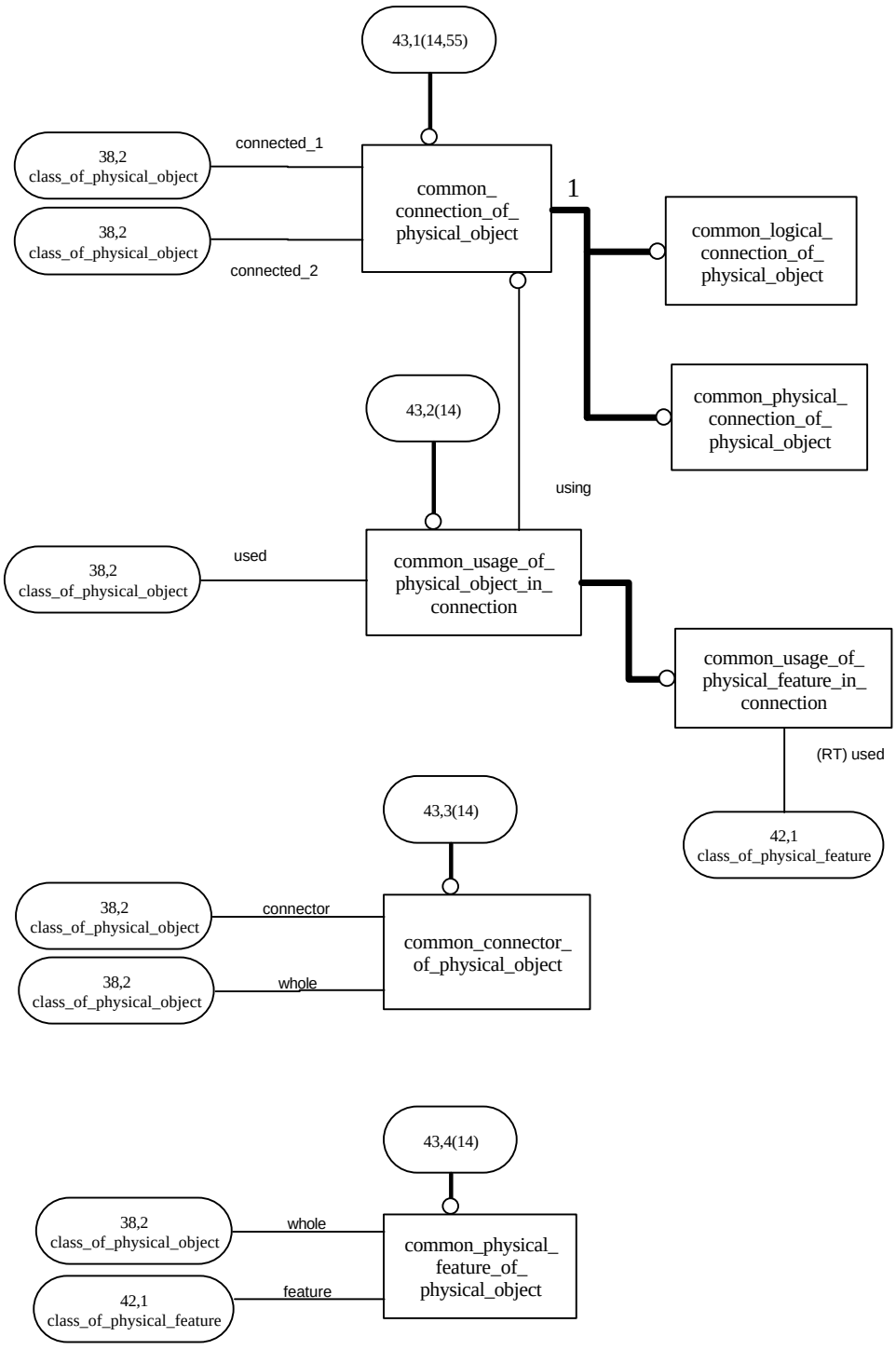


Figure 43 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common connection of physical object (2 of 2)

7.41 Placement of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.41.1 relative_placement_of_physical_object

A Relative_placement_of_physical_object is a Possessed_association that indicates the placed Physical_object is placed relative to the reference Physical_object. Details of the relative placement such as distance and bearing of the placed from the reference are Possessed_characteristics of the Relative_placement_of_physical_object.

EXAMPLE The relationship between Oslo and London that indicates that Oslo is 017 deg T and 759 nautical miles from London is a Relative_placement_of_physical_object.

EXPRESS specification:

```
*)
ENTITY relative_placement_of_physical_object
   SUBTYPE OF (possessed_association);
   placed     : physical_object;
   referenced : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

placed: The placed indicates the Physical_object whose position is being described relative to the reference Physical_object.

referenced: The referenced specifies the Physical_object that is the reference for the relative placement information.

7.41.2 segregation_of_physical_object

A Segregation_of_physical_object is a Possessed_association that indicates the object_1 Physical_object is separated and apart from, or out of direct contact with the object_2 Physical_object.

EXAMPLE The relationship between the physical objects inner layer and outer layer that indicates the layers do not touch is a Segregation_of_physical_object.

EXPRESS specification:

```
*)
ENTITY segregation_of_physical_object
   SUBTYPE OF (possessed_association);
   object_1 : physical_object;
   object_2 : physical_object;
END_ENTITY;
(*
```

7.41.3 usage_of_intermediate_physical_object_for_segregation

A Usage_of_intermediate_physical_object_for_segregation is a Common_association that indicates that the used Physical_object is used to segregate object_1 and object_2 of the using Segregation_of_physical_object.

EXAMPLE The relationship that indicates that the segregation of the Physical_objects "layer 1" and "layer 2" is maintained by the Physical_object "layer 3" is a Usage_of_intermediate_physical_object_for_segregation.

EXAMPLE 2 The relationship that indicates the segregation of the piston from the cylinder wall is maintained by the lubricating oil is a Usage_of_intermediate_physical_object_for_segregation.

EXPRESS specification:

```
*)
ENTITY usage_of_intermediate_physical_object_for_segregation
   SUBTYPE OF (possessed_association);
   used  : physical_object;
   using : segregation_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Physical_object that achieves the using Segregation_of_physical_object.

using: The using specifies the Segragation_of_physical_object that is maintained by the used Physical_object.

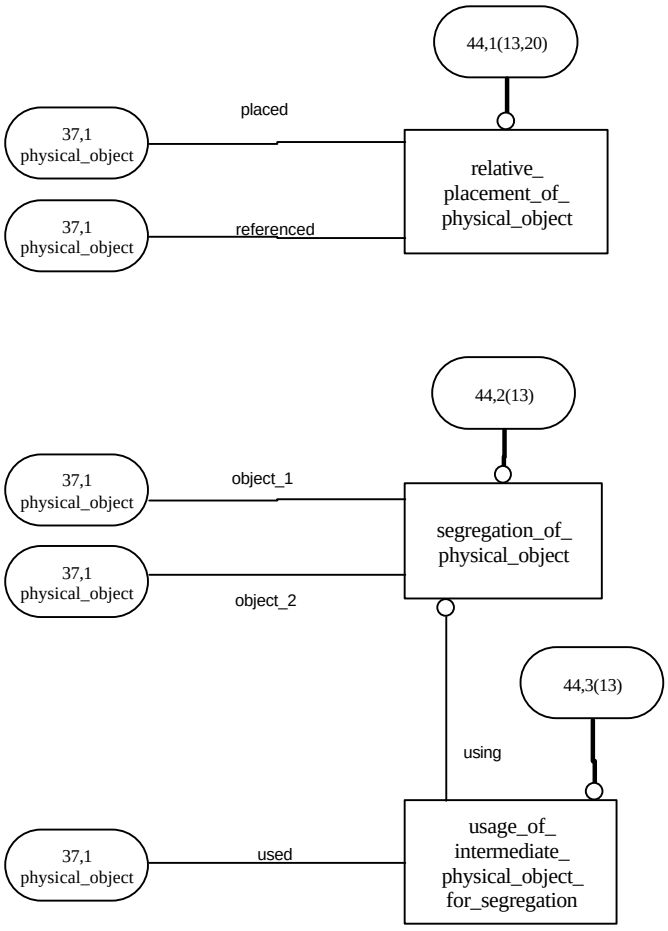


Figure 44 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Placement of physical object

7.42 Common placement of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.42.1 common_relative_placement_of_physical_object

A Common_relative_placement_of_physical_object is a Common_association that is a specialization of Relative_placement_of_physical_object that constrains members of the placed Class_of_physical_object to be placed relative to members of the referenced Class_of_physical_object.

EXAMPLE 1 The class of relationship between the class "survey monument" and the class "survey monument" that indicates that a monument is placed relative to at least two other referenced monuments is a Common_relative_placement_of_physical_object.

EXAMPLE 2 The class of relationship between the Class "Field X surveyed items" and the Class "Field X Survey monument" that indicates that each survey item is placed relative to at least one field monument is a Common_relative_placement_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_relative_placement_of_physical_object
   SUBTYPE OF (common_association);
   placed     : class_of_physical_object;
   referenced : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

placed: The placed specifies the Class_of_physical_object whose members may be placed relative to members of the referenced Class_of_physical_object.

The placed role corresponds to role_1 of the Common_association cardinality data.

referenced: The referenced specifies the Class_of_physical_object whose members act as the reference for a relative placement of members of the placed Class_of_physical_object.

The referenced corresponds to role_2 of the Common_association cardinality data.

7.42.2 common_segregation_of_physical_object

A Common_segregation_of_physical_object is a Common_association that is a specialization of Segregation_of_physical_object that constrains the members of Object_1 Class_of_physical_object to be segregated from members of the Object_2 Class_of_physical_object.

EXAMPLE The class of relationship between the Class "cable conductor" and the Class "cable conductor" that indicates cable conductors may be segregated from other cable conductors is a Common_segregation_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_segregation_of_physical_object
   SUBTYPE OF (common_association);
   object_1 : class_of_physical_object;
   object_2 : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

object_1: The object_1 specifies the Class_of_physical_object whose members are segregated from members of the object_2 Class_of_physical_object.

The object_1 role corresponds to the role_1 of the Common_association cardinality data.

object_2: The object_2 specifies the Class_of_physical_object whose members are segregated from members of the object_1 Class_of_physical_object.

The object_2 role corresponds to the role_2 of the Common_association cardinality data.

7.42.3 common_usage_of_intermediate_physical_object_for_segregation

A Common_usage_of_intermediate_physical_object_for_segregation is a Common_association that is a specialization of Usage_of_intermediate_physical_object_for_segregation that constrains the members of the using segregation class to be segregated by members of the used Class_of_physical_object.

EXAMPLE The class of relationship between the cable conductor common segregation and the class "conductor insulation" that indicates conductors may be segregated by conductor insulation is a Common_usage_of_intermediate_physical_object_for_segregation.

EXPRESS specification:

```
*)
ENTITY common_usage_of_intermediate_physical_object_for_segregation
   SUBTYPE OF (common_association);
   used  : class_of_physical_object;
   using : common_segregation_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

used: The used specifies the Class_of_physical_object whose members can be used to segregate members of the object_1 and object_2 Class_of_physical_object.

The used role corresponds to role_1 of the Common_association cardinality data.

using: The using specifies the Common_segregation_of_physical_object whose members can be segregated by members of the used Class_of_physical_object.

The using role corresponds to role_2 of the Common_association cardinality data.

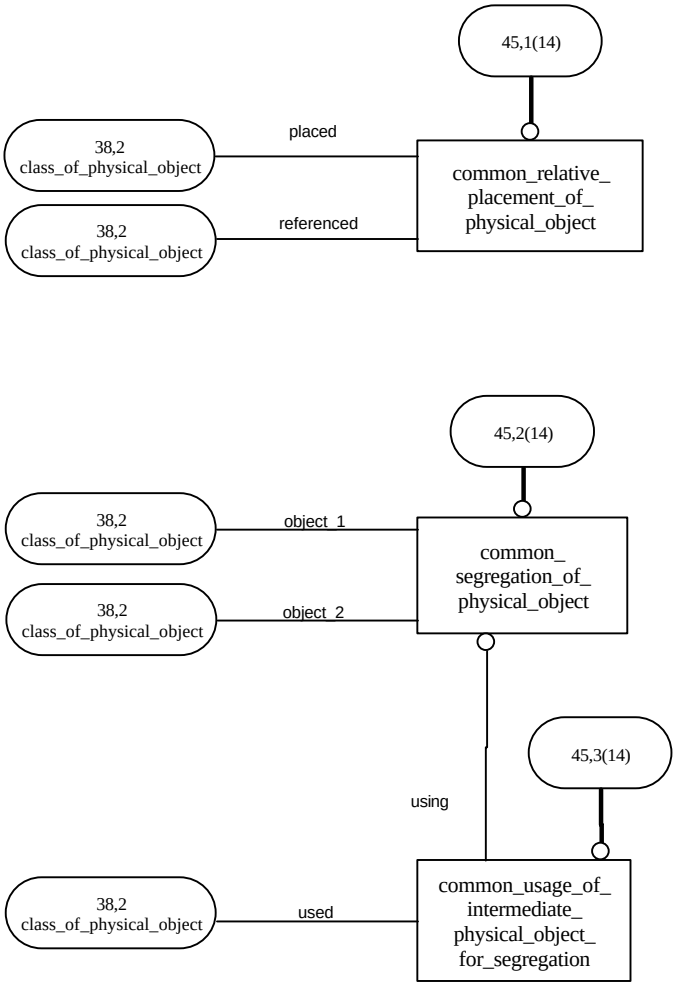


Figure 45 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common placement of physical object

7.43 Topologic sequence of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.43.1 composition_of_topologic_sequence_aspect_of_physical_object

A Composition_of_topologic_sequence_aspect_of_physical_object is a Composition_of_possessed_aspect that indicates that the part Toplogic_sequence_of_physical_object is a part of the whole Possessed_topologic_sequence_aspect_of_physical_object.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY composition_of_topologic_sequence_aspect_of_physical_object
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part :
      topologic_sequence_of_physical_object;
   SELF\composition_of_possessed_aspect.whole :
      possessed_topologic_sequence_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Topologic_sequence_of_physical_object that is a part of the whole Possessed_topologic_sequence_aspect_of_physical_object.

whole: The whole specifies the Possessed_topologic_sequence_aspect_of_physical_object that the part Topologic_sequence_of_physical_object is part of.

7.43.2 possessed_topologic_sequence_aspect_of_physical_object

A Possessed_topologic_sequence_aspect_of_physical_object is a Possessed_aspect that is a composition of Topologic_sequence_of_physical_object describing an ordering of parts of the possessor Physical_object.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY possessed_topologic_sequence_aspect_of_physical_object
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Physical_object that possesses the topologic sequence as an aspect.

7.43.3 topologic_sequence_of_physical_object

A Topologic_sequence_of_physical_object is a Possessed_association that indicates the predecessor Physical_object is occurs in space before the successor Physical_object.

EXAMPLE The relationship between the Layer 1 Physical_object and the Layer 2 Physical_object that indicates that Layer 1 is before Layer 2 is a Topologic_sequence_of_physical_object.

EXPRESS specification:

```
*)
ENTITY topologic_sequence_of_physical_object
   SUBTYPE OF (possessed_association);
   predecessor : physical_object;
   successor   : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Physical_object that is adjacent to the successor Physical_object.

successor: The successor specifies the Physical_object that is adjacent to the predecessor Physical_object.

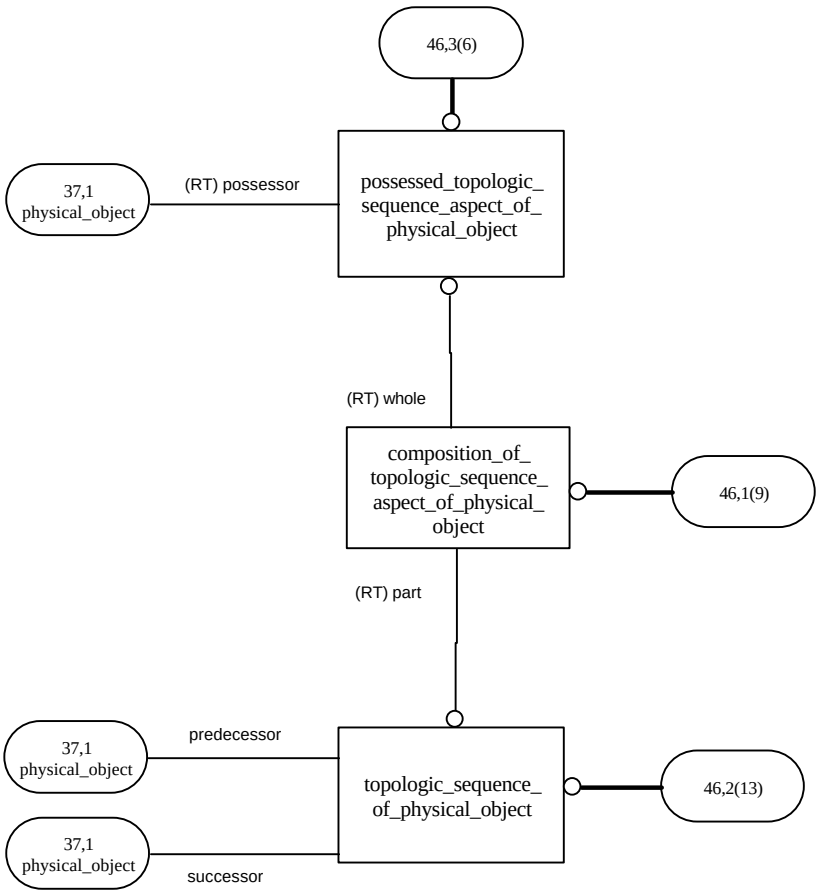


Figure 46 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Topologic sequence of physical object

7.44 Common topologic sequence of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.44.1 common_composition_of_topologic_sequence_aspect_of_physical_object

A Common_composition_of_topologic_sequence_aspect_of_physical_object is a Common_composition_of_aspect that is a specialization of Composition_of_topologic_sequence_aspect_of_physical_object that constrains the types of sequence relationships that can be parts of members of the whole Common_topologic_sequence_aspect_of_physical_object.

EXAMPLE ??

EXPRESS specification:

```
*)
ENTITY common_composition_of_topologic_sequence_aspect_of_physical_object
   SUBTYPE OF (common_composition_of_aspect);
   SELF\common_composition_of_aspect.part :
      common_topologic_sequence_of_physical_object;
   SELF\common_composition_of_aspect.whole :
      common_topologic_sequence_aspect_of_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Common_topologic_sequence_aspect_of_physical_object whose members are parts of the whole Common_topologic_sequence_of_physical_object.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Common_topologic_sequence_aspect_of_physical_object whose members have members of the part Common_topologic_sequence_of_physical_object as parts.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.44.2 common_possession_of_topologic_sequence_aspect_by_physical_object

A Common_possession_of_topologic_sequence_aspect_by_physical_object is a Common_association that is a specialization of the possessor class of relationships that constrains members of the Class_of_physical_object to possess members of the Common_topological_sequence_aspect_of_physical_object.

EXAMPLE The class of relationships that indicate that Type X Cross tree manifolds possess a Type X end arrangement, whereby certain types of ends are adjacent to other types of ends, is a Common_possession_of_topologic_sequence_aspect_by_physical_object.

EXPRESS specification:

```
*)
ENTITY common_possession_of_topologic_sequence_aspect_by_physical_object
   SUBTYPE OF (common_association);
possessed : common_topologic_sequence_aspect_of_of_physical_object;
possessor : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Common_topologic_sequence_aspect_of_physical_object whose members are possessed by members of the possessor
Class_of_physical_object.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class_of_physical_object whose members possess members of the Common_topologic_sequence_aspect_of_physical_object.

The possessor role corresponds to role_2 of the Common_association cardinality data.

7.44.3 common_topologic_sequence_aspect_of_of_physical_object

A Common_topologic_sequence_aspect_of_physical_object is a Common_aspect that is a specialization of Topologic_sequence_aspect_of_physical_object that constrains members of the topologic aspect to be made up of topologic sequence associations between certain types of physical object.

EXAMPLE The type of arrangement of the ends of the Type X pipe manifold is a Common_topologic_sequence_aspect_of_physical_object that is possessed by the Type X manifold Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_topologic_sequence_aspect_of_of_physical_object
   SUBTYPE OF (common_aspect);
END_ENTITY;
(*
```

7.44.4 common_topologic_sequence_of_physical_object

A Common_topologic_sequence_of_physical_object is a Common_association that is a specialization of Topologic_sequence_of_physical_object that constrains the members of the predecessor Class_of_physical_object to be adjacent to and before members of the successor Class_of_physical_object.

EXAMPLE A type X cross pipe manifold consists of four ends, A, B, C & D. The ends are positions such that A is next to D and B, B is next to A and C, C is next to B and D, and D is next to C and A. The relationships between the Class_of_physical_object "End A of Manifold type X" and the Class_of_physical_object "End B of Manifold type X" that indicates A is adjacent to B is a Common_topologic_sequence_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_topologic_sequence_of_physical_object
   SUBTYPE OF (common_association);
   predecessor : class_of_physical_object;
   successor   : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Class_of_physical_object whose members are adjacent to and before members of the successor Class_of_physical_object.

The predecessor role corresponds to role_1 of the Common_association cardinality data.

successor: The successor specifies the Class_of_physical_object whose members are adjacent to and after members of the predecessor Class_of_physical_object.

The successor role corresponds to role_2 of the Common_association cardinality data.

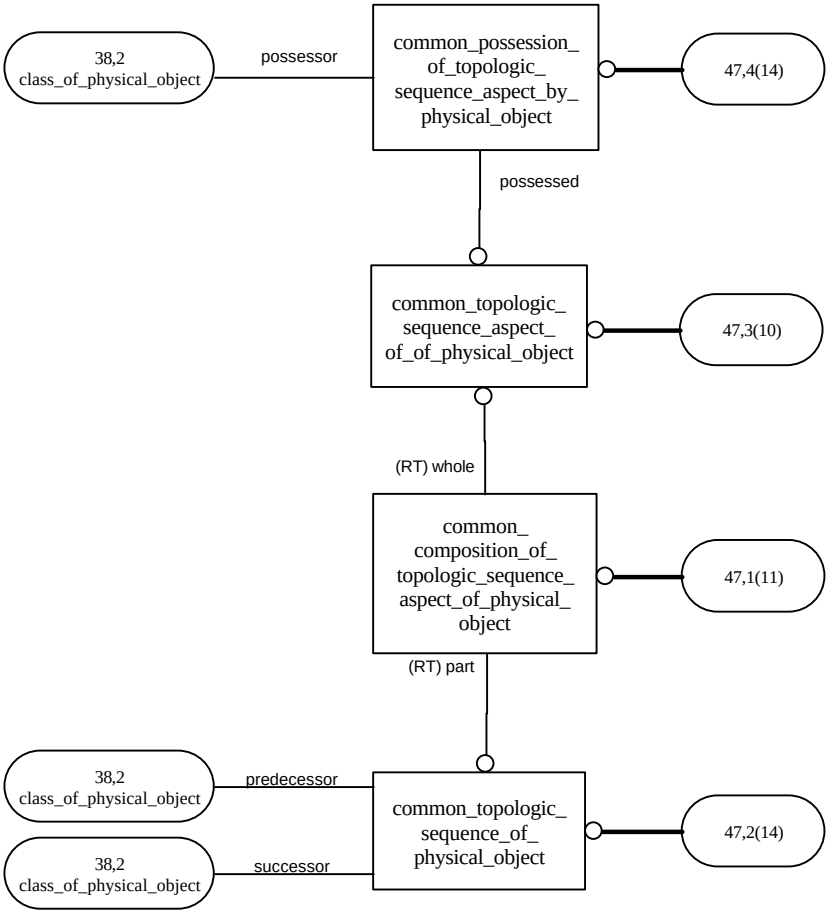


Figure 47 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common topologic sequence of physical object

7.45 Protection of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.45.1 common_purpose_of_possessed_protection

A Common_purpose_of_possessed_protection is a Common_association that is a specialization of Protection_from_hazard that constrains the aspect Protection_of_physical_object to prevent members of the purpose Class_of_activity from happenning.

EXAMPLE The class of relationship between the engine anode protection and the Class_of_activity electrolytic corrosion that indicates the engine is protected from any electrolytic corrosion is a Common_purpose_of_possessed_protection.

The aspect cardinality is one and only one at one time and one to many over time. The purpose cardinality is one to many at a point in time and over time.

EXPRESS specification:

```
*)
ENTITY common_purpose_of_possessed_protection
   SUBTYPE OF (common_purpose_of_possessed_aspect);
   SELF\common_purpose_of_possessed_aspect.aspect : protection_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Protection_of_physical_object that is preventing members of the purpose Class_of_activity.

The aspect role corresponds to role_1 of the Common_association cardinality data.

7.45.2 protection_from_hazard

A Protection_from_hazard is a Purpose_of_possessed_aspect that indicates the activity the aspect Protection_of_physical_object is preventing from happenning.

EXAMPLE The relationship between the engine anode protection and the activity "the engine corrosion" that indicates the protection prevents the actual corrosion process is a Protection_from_hazard.

EXPRESS specification:

```
*)
ENTITY protection_from_hazard
   SUBTYPE OF (purpose_of_possessed_aspect);
   SELF\purpose_of_possessed_aspect.aspect : protection_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the protection association where the protected is protected from the purpose activity.

7.45.3 protection_of_physical_object

A protection_of_physical_object is a Possessed_association that indicates the protected Physical_object is protected by the protector Physical_object.

The protection from hazard associations may indicate the hazardous activity that is being prevented by the protection.

EXAMPLE The relationship between the ships engine and the sacrificial anode that indicates the anode is protecting the engine is a Protection_of_physical_object.

EXPRESS specification:

```
*)
ENTITY protection_of_physical_object
   SUBTYPE OF (possessed_association);
   protected : physical_object;
   protector : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

protected: The protected specifies the Physical_object that is protected by the protector Physical_object.

protector: The protector specifies the Physical_object that is protecting the protected Physical_object.

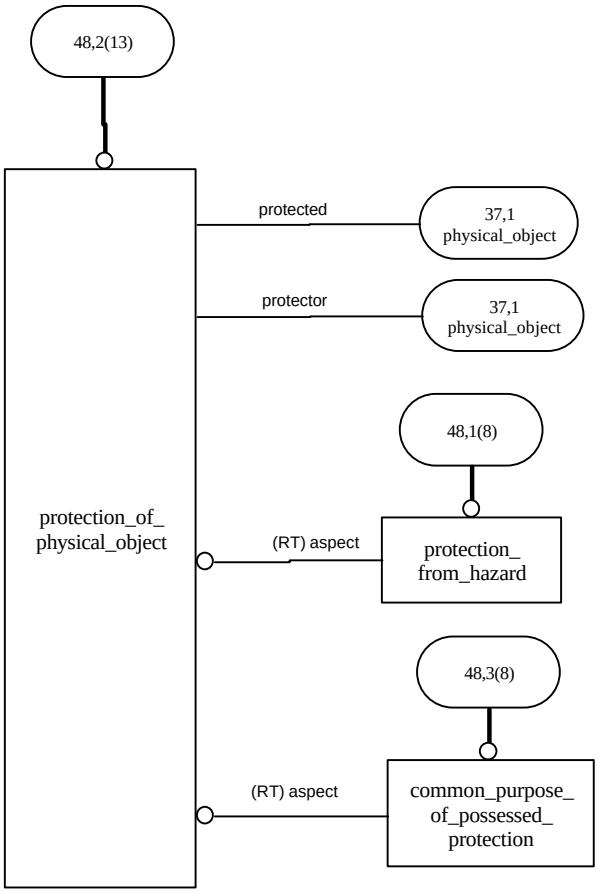


Figure 48 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Protection of physical object

7.46 Common protection of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.46.1 common_protection_of_physical_object

A Common_protection_of_physical_object is a Common_association that is a specialization of Protection_of_physical_object that constrains members of the protected Class_of_physical_object to be protected by members of the protector Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "installed marine engine" and the Class_of_physical_object "sacrificial anode" indicating that members of the engine class may be protected by members of the anode class is a Common_protection_of_physical_object.

In this example the cardinality of the protected is zero to many at a point in time and over all time. The cardinality of the protector is zero to one at a point in time and zero to many over time.

EXPRESS specification:

```
*)
ENTITY common_protection_of_physical_object
   SUBTYPE OF (common_association);
   protected : class_of_physical_object;
   protector : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

protected: The protected specifies the Class_of_physical_object whose members are protected by members of the protector Class_of_physical_object.

The protector role corresponds to role_1 of the Common_association cardinality data.

protector: The protector specifies the Class_of_physical_object whose members protect members of the protected Class_of_physical_object.

The protected role corresponds to role_2 of the Common_association cardinality data.

7.46.2 common_purpose_of_common_protection

A Common_purpose_of_common_protection is a Common_purpose_of_aspect that is a specialisation of Protection_from_hazard that constrains the protection relationships to those that prevent members of the purpose class_of_activity from happening.

EXAMPLE The class of relationship between the "installed marine engine" common protection and the "electrolytic corrosion" Class_of_activity, indicating that the protection prevents corrosion is a Common_purpose_of_common_protection.

EXPRESS specification:

```
*)
ENTITY common_purpose_of_common_protection
   SUBTYPE OF (common_purpose_of_aspect);
   SELF\common_purpose_of_aspect.aspect : common_protection_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

aspect: The aspect specifies the Common_protection_of_physical_object whose members prevent members of the purpose class_of_activity from happening.

The aspect role corresponds to role_1 of the common_association cardinality data.

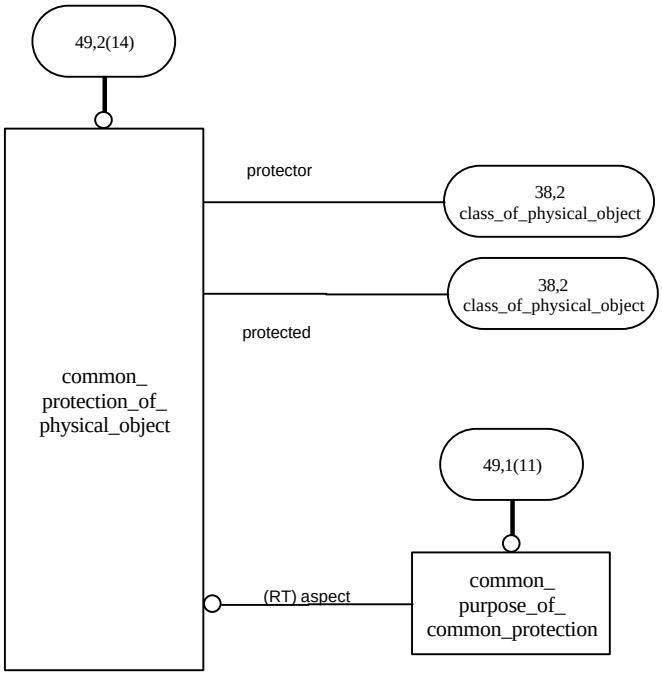


Figure 49 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common protection of physical object

7.47 Redundancy of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.47.1 redundancy_of_physical_object

A Redundancy_of_physical_object is a Possessed_association that indicates the redundant Physical_object is available, in the event of breakdown or failure, to take over the tasks of the basis Physical_object.

EXAMPLE The relationship between the Materialized_physical_object "the blue pump" and the Materialized_physical_object "the green pump" indicating that the green pump is on standby for the blue pump is a Redundancy_of_physical_object.

EXPRESS specification:

```
*)
ENTITY redundancy_of_physical_object
   SUBTYPE OF (possessed_association);
basis : physical_object;
redundant : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

basis: The basis specifies the Physical_object that can be replaced by the redundant Physical_object.

redundant: The redundant specifies the Physical_object that is on standby to take over the role of the basis Physical_object.

7.47.2 representative_association_between_physical_objects

A Representative_association_between_physical_objects is a Possessed_association that indicates the representing Physical_object is a representative sample of the represented Physical_object.

EXAMPLE The relationship between the Materialized_physical_object "sample #29" and the Materialized_physical_object "batch 56" indicating the sample is representative of the batch is a Representative_association_between_physical_objects.

EXAMPLE 2 The relationship between the Person Mr Smith and the Plural Individual Employees of XYZ Co., indicating that Mr Smith is a typical employee of the Company is a Representative_association_between_physical_objects.

EXPRESS specification:

```
*)
ENTITY representative_association_between_physical_objects
   SUBTYPE OF (possessed_association);
   represented : physical_object;
   representing : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

represented: The represented specifies the Physical_object that the representing Physical_object is a representative sample of.

representing: The representing specifies the Physical_object that is a representative sample of the represented Physical_object.

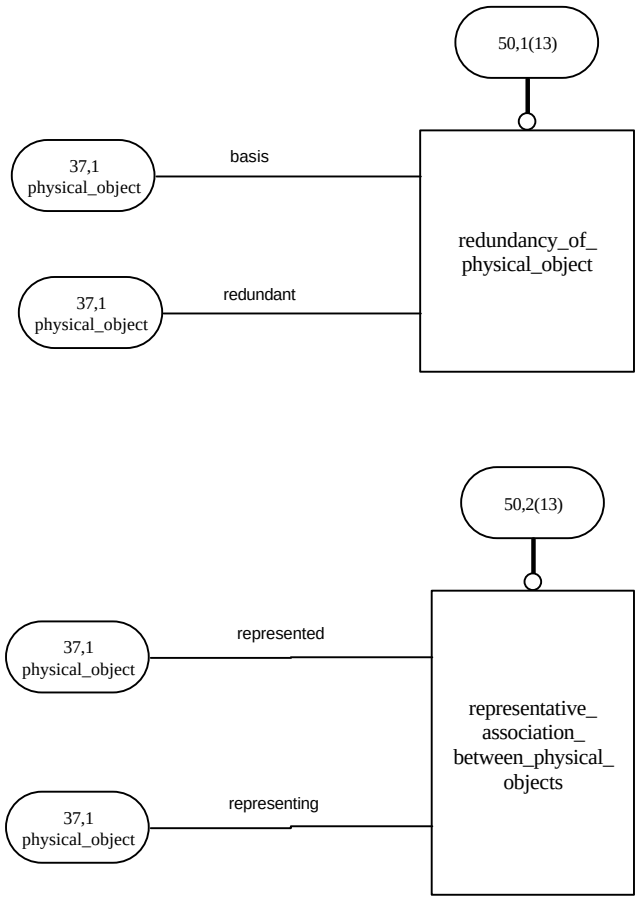


Figure 50 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Redundancy of physical object

7.48 Common redundancy of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.48.1 common_redundancy_of_physical_object

A Common_redundancy_of_physical_object is a Common_association that is a specialization of Redundancy_of_physical_object that constrains the members of the redundant Class_of_physical_object to be standbys for members of the basis Class_of_physical_object.

EXAMPLE The class of relationship between the Class_of_physical_object "installed M2 impeller" and the Class_of_physical_object "spare M2 impeller" that indicates that the spare impellers are on held as replacement parts for the installed impellers is a Common_redundancy_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_redundancy_of_physical_object
   SUBTYPE OF (common_association);
   basis     : class_of_physical_object;
   redundant : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

basis: The basis specifies the Class_of_physical_object whose members have members of the redundant Class_of_physical_object as standbys.

The basis role corresponds to role_1 of the Common_association cardinality data.

redundant: The redundant specifies the Class_of_physical_object whose members are on standby for members of the basis Class_of_physical_object.

The redundant role corresponds to role_2 of the Common_association cardinality data.

7.48.2 common_representative_association_between_physical_object

A Common_representative_association_between_physical_object is a Common_association that is a specialization of Representative_association_between_physical_objects constraining members of the represented Class_of_physical_object to have members of the representing Class_of_physical_object as representative samples.

EXAMPLE The class of relationship between the Class_of_physical_object "Oil" and the Class_of_physcal_object "Oil sample" indicating members of the oil sample class are samples of members of the oil class is a Common_representative_association_between_physical_object.

EXPRESS specification:

```
*)
ENTITY common_representative_association_between_physical_object
   SUBTYPE OF (common_association);
   represented  : class_of_physical_object;
   representing : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

represented: The represented specifies the Class_of_physical_object whose members have members of the representative Class_of_physical_object as representative samples.

The represented role corresponds to role_1 of the Common_association cardinality data.

representing: The representing specifies the Class_of_physical_object whose members may be representative samples of the members of the represented Class_of_physical_object.

The representing role corresponds to role_2 of the Common_association cardinality data.

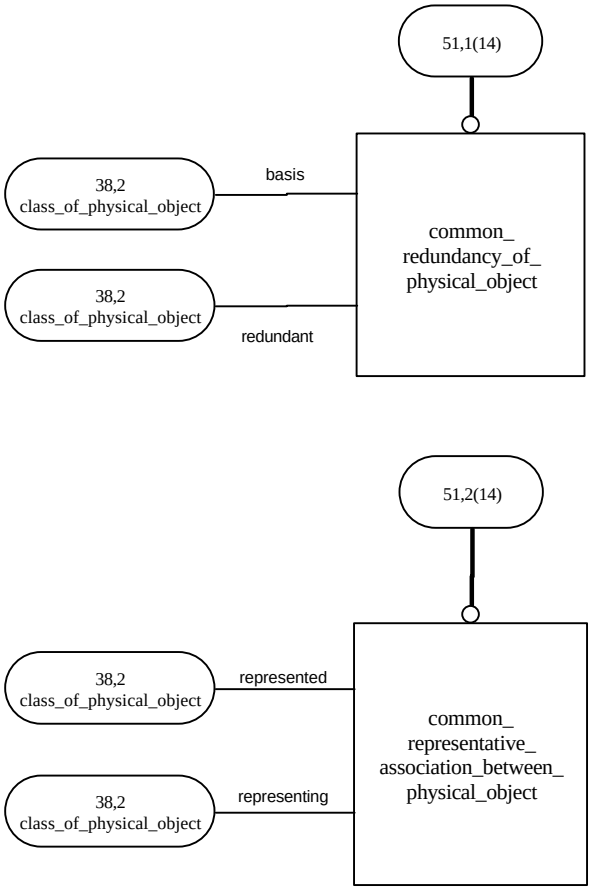


Figure 51 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common redundancy of physical object

7.49 Role in life of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.49.1 classification_of_role_in_life_of_physical_object

A Classification_of_role_in_life_of_physical_object is an Essential_classification_of_possessed_association that indicates the classified Role_of_person_or_organization_in_life_of_physical_object is a member of the classifier Class_of_role.

EXAMPLE The relationship between the Role_of_person_or_organization_in_life_of_physical_object relationship between the Organization "XYZ Co." and the "Physical_object" "Pump #1234", and the Class_of_role "manufacturer" indicating XYZ Co is the manufacturer of the pump is a Classification_of_role_in_life_of_physical_object.

EXPRESS specification:

```
*)
ENTITY classification_of_role_in_life_of_physical_object
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified :
      role_of_person_or_organization_in_life_of_physical_object;
   SELF\classification_of_individual.classifier : class_of_role;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Role_of_person_or_organization_in_life_of_physical_object that is a member of the classifier Class_of_role.

classifier: The classifier specifies the Class_of_role whose members include the classified Role_of_person_or_organization_in_life_of_physical_object.

7.49.2 role_of_person_or_organization_in_life_of_physical_object

A Role_of_person_or_organization_in_life_of_physical_object is a Possessed_association that indicates that the actions of the role_player Person or Organization affects the physical_object.

EXAMPLE The relationship between the Organization "XYZ Co." and the Physical_object "pump #1234" that indicates XYZ Co. manufactured the pump is a Role_of_person_or_organization_in_life_of_physical_object.

EXPRESS specification:

```
*)
ENTITY role_of_person_or_organization_in_life_of_physical_object
   SUBTYPE OF (possessed_association);
   role_player     : person_or_organization;
   physical_object : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

role_player: The role_player specifies the Person or Organization that plays a role in the life of the physical_object.

physical_object: The physical_object specifies the Physical_object that is affected by the role_player Person or Organization.

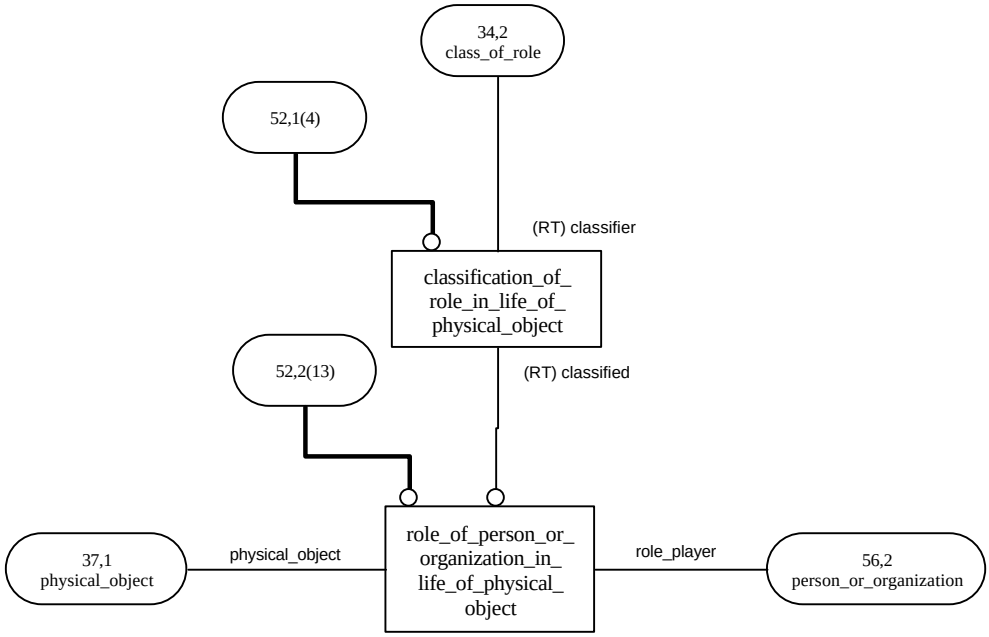


Figure 52 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Role in life of physical object

7.50 Common role in life of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.50.1 class_of_person_or_class_of_organization

A Class_of_person_or_class_of_organization is a Class_of_person or a Class_of_organization.

EXPRESS specification:

```
*)
TYPE class_of_person_or_class_of_organization = SELECT
  (class_of_person,
   class_of_organization);
END_TYPE;
(*
```

7.50.2 common_role_of_person_or_organization_in_life_of_physical_object

A Common_role_of_person_or_organization_in_life_of_physical_object is a Common_association that is a specialization of Role_of_person_or_organization_in_life_of_physical_object that constrains the members of the Class_of_physical_object to be affected by the actions of members of the role_player Class_of_person or Class_of_organization.

NOTE The type of role of the role_player is indicated by a Specialization_of_class relationship to a Class_of_role.

EXAMPLE The class of relationship between the Class_of_physical_object "Heavy duty pump" and the Class_of_person "mechanical engineer" that indicates that heavy duty pumps must be maintained by mechanical engineers is a Common_role_of_person_or_organization_in_life_of_physical_object. The class of relationship of this example is a specialization of the Class_of_role "maintainer".

EXPRESS specification:

```
*)
ENTITY common_role_of_person_or_organization_in_life_of_physical_object
   SUBTYPE OF (common_association);
   class       : class_of_physical_object;
   role_player : class_of_person_or_class_of_organization;
END_ENTITY;
(*
```

Attribute definitions:

class: The class specifies the Class_of_physical_object whose members are affected by the actions of the members of the role_player class.

The class role corresponds to role_1 of the Common_association cardinality data.

role_player: The role_player specifies the Class_of_person or Class_of_organization whose members affect members of the class Class_of_physical_object.

The role_player role corresponds to role_2 of the Common_association cardinality data.

7.50.3 role_of_person_or_organization_in_life_of_members_of_class_of_physical_object

A Role_of_person_or_organization_in_life_of_members_of_class_of_physical_object is a Common_association that is a specialization of Role_of_person_or_organization_in_life_of_physical_object that constrains the members of class to be affected by the actions of the role_player Person or Organization.

Note the type of role the role_player has is indicated by a Specialization_of_class relationship to a Class_of_role.

EXAMPLE The class of relationship between the Class of physical_object "Type 2a pump" and the the Organisation "XYZ Co." that indicates that members of the class are only manufactured by the XYZ Co. is a Role_of_person_or_organization_in_life_of_members_of_class_of_physical_object. The cardinality of the class role is one to one, at a point in time and for all time. The cardinality of the role_plaver is zero to many, at a point in time and for all time. The class of relationship of this example is a specialization of the Class_of_role "manufacturer".

EXPRESS specification:

```
*)
ENTITY
role_of_person_or_organization_in_life_of_members_of_class_of_physical_object
   SUBTYPE OF (common_association);
   class       : class_of_physical_object;
   role_player : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

class: The class specifies the Class_of_physical_object whose members are affected by the role_player Person or Organization.

The class role corresponds to role_1 of the Common_association cardinality data.

role_player: The role_player specifies the Person or Organization whose actions affect members of the class Class_of_physical_object.

The role_player role corresponds to role_2 of the Common_association cardinality data.

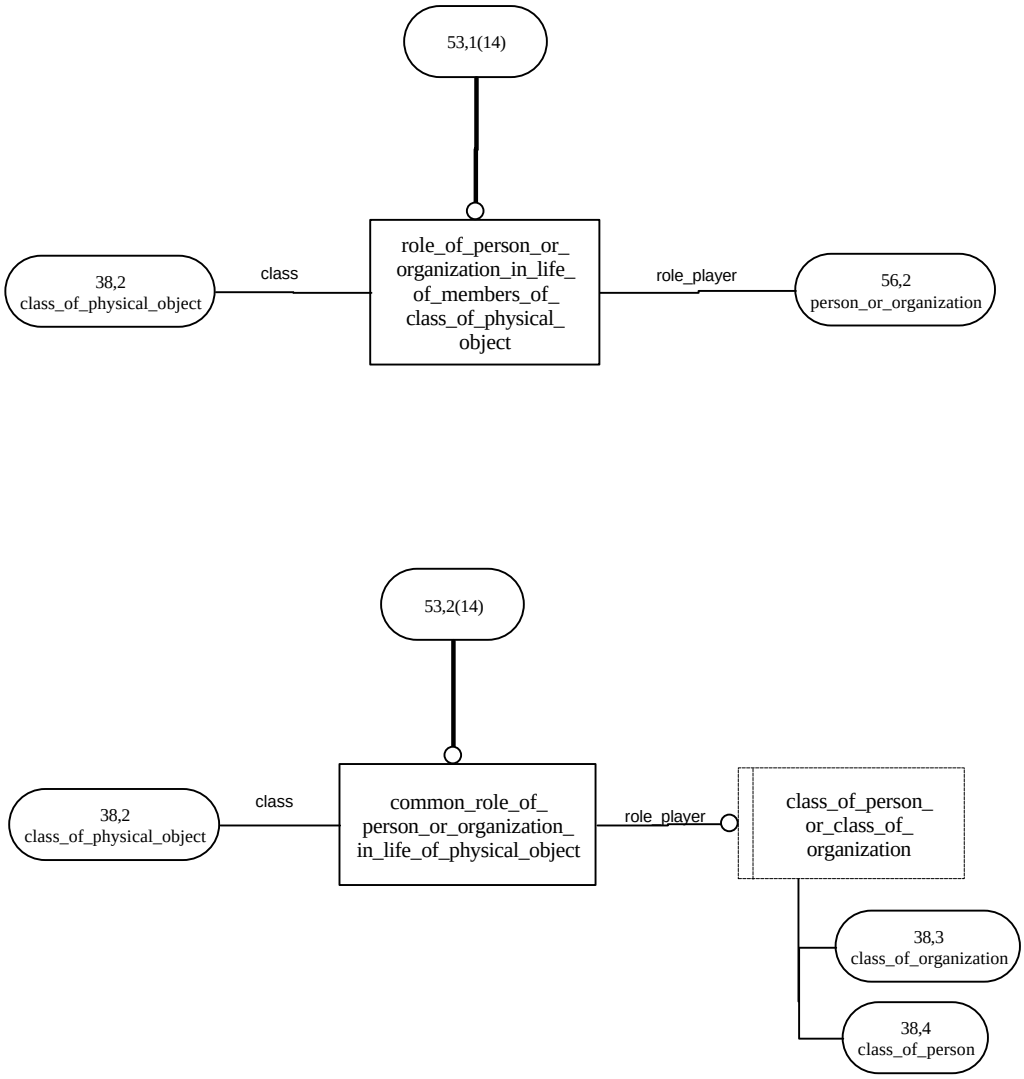


Figure 53 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common role in life of physical object

7.51 Routing aspect of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.51.1 composition_of_routing_aspect_of_physical_object

A Composition_of_routing_aspect_of_physical_object is a Composition_of_possessed_aspect that indicates the part Connection_of_physical_object is a part of the whole routing aspect.

EXAMPLE If a route includes the connection A-B, then the relationship between the route and the Connection_of_physical_object A-B is a Composition_of_routing_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY composition_of_routing_aspect_of_physical_object
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part : connection_of_physical_object;
   SELF\composition_of_possessed_aspect.whole :
      possessed_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Connection_of_physical_object that is a part of the whole Possessed_routing_aspect_of_physical_object.

whole: Th whole specifies the Possessed_routing_aspect_of_physical_object that the part Connection_of_physical_object is a part of.

7.51.2 destination_of_route

A Destination_of_route is a Possessed_association that indicates the destination Physical_object of the route Possessed_routing_aspect_of_physical_object.

EXAMPLE If a route comprises of connections A-B, B-C, C-D with destination D, then the relationship between this route and Physical_object D is a Destination_of_route.

EXPRESS specification:

```
*)
ENTITY destination_of_route
   SUBTYPE OF (possessed_association);
   destination : physical_object;
   route       : possessed_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

destination: The destination specifies the Physical_object that terminates the route Possessed_routing_aspect_of_physical_object.

route: The route specifies the Possessed_routing_aspect_of_physical_object that is terminated by the destination Physical_object.

7.51.3 physical_object_following_route

The Physical_object_following_route is a Possessed_association that indicates that the Physical_object is moving along or has moved along the route.

Note. This seems to be an activity !

EXAMPLE The relationship between the Physical_object Batch #27 and Route #7 of the plant that indicates that the batch is moving along the route is a Physical_object_following_route.

EXPRESS specification:

```
*)
ENTITY physical_object_following_route
   SUBTYPE OF (possessed_association);
   object : physical_object;
   route  : possessed_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

object: The object specifies the Physical_object that is following the route.

route: The route specifies the Possessed_routing_aspect_of_physical_object that is followed by the object Physical_object.

7.51.4 possessed_routing_aspect_of_physical_object

A Possessed_routing_aspect_of_physical_object is a Possessed_aspect that is a route that comprises of a set of connections that begin and end at a connected part of the possessor Physical_object.

EXAMPLE Consider a collection of process units, transfer lines, manifolds and tanks that is a Plural individual and a Physical_object. There can be many routes that start and end at a process unit or tank, each defined by a set of connections. Each such route is a Possessed_routing_aspect_of_physical_object possessed by the collection of process units.

EXPRESS specification:

```
*)
ENTITY possessed_routing_aspect_of_physical_object
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Physical_object that possesses the Possessed_routing_aspect_of_physical_object.

7.51.5 source_of_route

Source_of_route is a Possessed_association that indicates the beginning Physical_object of the route Possessed_routing_aspect_of_physical_object.

EXAMPLE If a route starts at A and comprises connections A-B, B-C, C-D, then the relationship between this route and Physical_object A is a Source_of_route.

EXPRESS specification:

```
*)
ENTITY source_of_route
   SUBTYPE OF (possessed_association);
   route  : possessed_routing_aspect_of_physical_object;
   source : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

route: The route specifies the Possessed_routing_aspect_of_physical_object that begins at the source Physical_object.

source: The source specifies the Physical_object that begins the route Possessed_routing_aspect_of_physical_object.

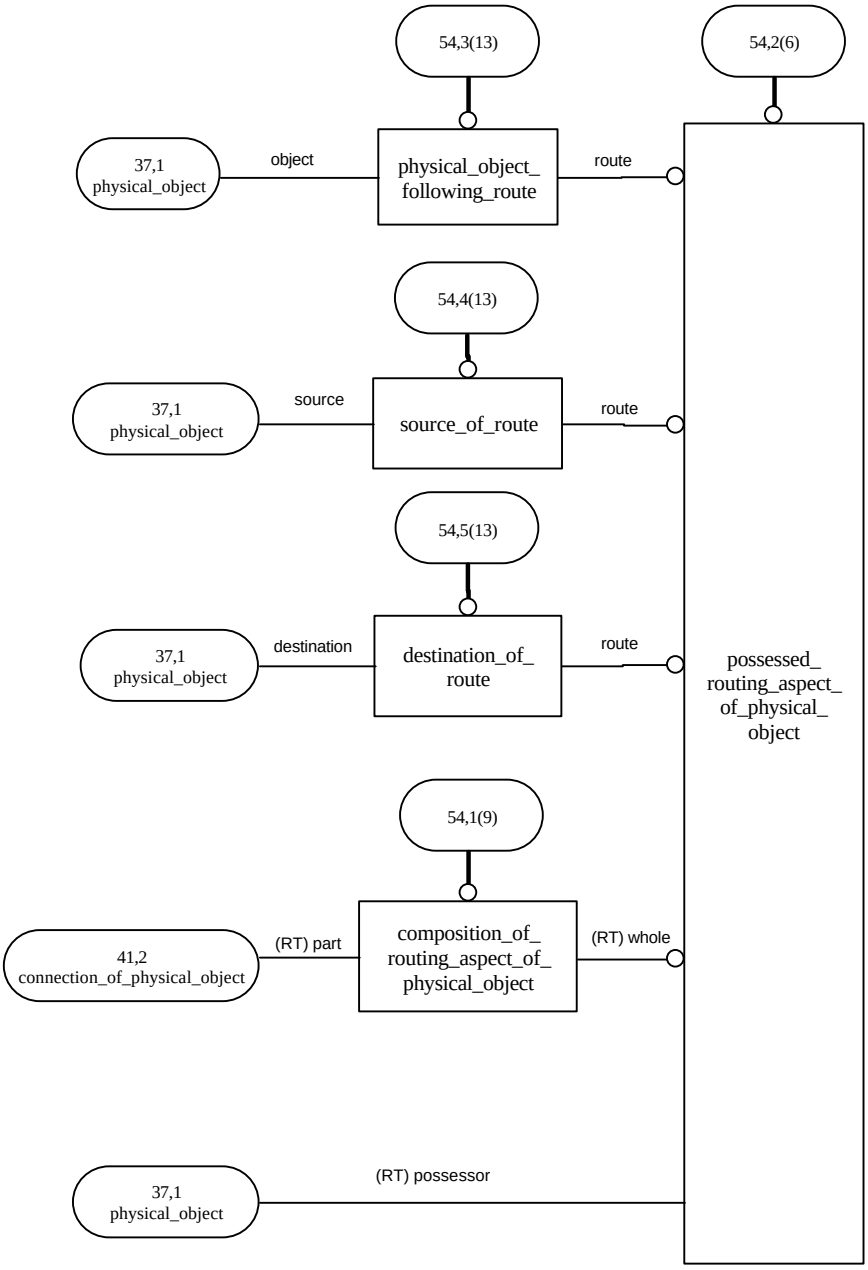


Figure 54 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Routing aspect of physical object

7.52 Common routing aspect of physical object

A description of the uses of the entity types shown in this section will go here, eventually.

7.52.1 common_composition_of_routing_aspect_of_physical_object

A Common_composition_of_routing_aspect_of_physical_object is a Common_composition_of_aspect that is a specialization of Composition_of_routing_aspect_of_physical_object that constrains the connections that make up a type of route to connect certain types of physical_object.

EXAMPLE The class of relationships between the Common_routing_aspect_of_physical_object "LP gas transfer route" and the Common_connection_of_physical_object that include only connections between LP gas system components is a Common_composition_of_routing_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_composition_of_routing_aspect_of_physical_object
   SUBTYPE OF (common_composition_of_aspect);
   SELF\common_composition_of_aspect.part : common_connection_of_physical_object;
   SELF\common_composition_of_aspect.whole :
      common_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Common_connection_of_physical_object whose members can be parts of members of the whole Common_routing_aspect_of_physical_object.

The part role corresponds to role_1 of the Common_association cardinality data.

whole: The whole specifies the Common_routing_aspect_of_physical_object whose members can have members of the part Common_connection_of_physical_object as parts.

The whole role corresponds to role_2 of the Common_association cardinality data.

7.52.2 common_destination_of_route

A Common_destination_of_route is a Common_association that is a specialisation of Destination_of_route that constrains the members of the route class to terminate at a member of the destination Class_of_physical_object.

EXAMPLE The class of relationship between the LP gas flare routes that connect LP gas oil separators and the Class_of_physical_object LP Flare that indicate that the routes terminate at a LP Flare is a Common_destination_of_route.

EXPRESS specification:

```
*)
ENTITY common_destination_of_route
   SUBTYPE OF (common_association);
   destination : class_of_physical_object;
   route       : common_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

destination: The destination specifies the Class_of_physical_object whose members may terminate members of the route class.

The destination role corresponds to role_1 of the Common_association cardinality data.

route: The route specifies the Common_routing_aspect_of_physical_object whose members may terminate at members of the destination Class_of_physical_object.

The route role corresponds to role_2 of the Common_association cardinality data.

7.52.3 common_physical_object_following_route

A Common_physical_object_following_route is a Common_association that is a specialisation of Physical_object_following_route that constrains members of the class Class_of_physical_object to be moving along the members of the route class.

EXAMPLE The class of relationship between the Class_of_physical_object "Plant LP Flared Gas" and the Common_routing_aspect_of_physical_object "LP Flare gas routes" is a Common_physical_object_following_route.

EXPRESS specification:

```
*)
ENTITY common_physical_object_following_route
   SUBTYPE OF (common_association);
   object : class_of_physical_object;
   route  : common_routing_aspect_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

object: The object specifies the Class_of_physical_object whose members can follow members of the route class.

The object role corresponds to role_1 of the Common_association cardinality data.

route: The route specifies the Common_routing_aspect_of_physical_object whose members are followed by members of the object Class_of_physical_object.

The route role corresponds to role_2 of the Common_association cardinality data.

7.52.4 common_possession_of_routing_aspect_of_physical_object

A Common_possession_of_routing_aspect_of_physical_object is a Common_association that is a specialization of the possession of aspect relationship that constrains the members of the possessor Class_of_physical_object to possess members of the possessed Common_routing_aspect_of_physical_object.

EXAMPLE The class of relationships between a Class_of_physical_object "Gas oil separation plant" and a Common_routing_aspect_of_physical_object "LP gas flare" indicating that this type of physical object has these types of routes is a Common_routing_aspect_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_possession_of_routing_aspect_of_physical_object
   SUBTYPE OF (common_association);
   possessed : common_routing_aspect_of_physical_object;
   possessor : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

possessed: The possessed specifies the Common_routing_aspect_of_physical_object whose members are possessed by members of the possessor Class_of_physical_object.

The possessed role corresponds to role_1 of the Common_association cardinality data.

possessor: The possessor specifies the Class_of_physical_object whose members possess members of the possessed Common_routing_aspect_of_physical_object.

The possessor role corresponds to role_2 of the Common_association cardinality data.

7.52.5 common_routing_aspect_of_physical_object

A Common_routing_aspect_of_physical_object is a Common_aspect that is indicates a common nature of members of Possessed_routing_aspect_of_physical_object that may be possessed by Physical_objects.

EXAMPLE LP Gas flare that are routes that LP gas can flow to the LP flares is a Common_routing_aspect_of_physical_object

EXPRESS specification:

```
*)
ENTITY common_routing_aspect_of_physical_object
   SUBTYPE OF (common_aspect);
END_ENTITY;
(*
```

7.52.6 common_source_of_route

A Common_source_of_route is a Common_association that is a specialization of Source_of_route that constrains the members of the route class to begin at a member of the source Class_of_physical_object.

EXAMPLE The class of relationship between the LP gas flare routes that connect LP gas oil separators and the Class_of_physical_object "LP gas separator" that indicate that the routes begin at a LP gas separator is a Common_source_of_route.

EXPRESS specification:

```
*)
ENTITY common_source_of_route
   SUBTYPE OF (common_association);
   route  : common_routing_aspect_of_physical_object;
   source : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

route: The route specifies the Common_routing_aspect_of_physical_object whose members may begin at members of the source Class_of_physical_object.

The route role corresponds to role_1 of the Common_association cardinality data.

source: The source specifies the Class_of_physical_object whose members may be the beginning of members of the route class.

The source role corresponds to role_2 of the Common_association cardinality data.

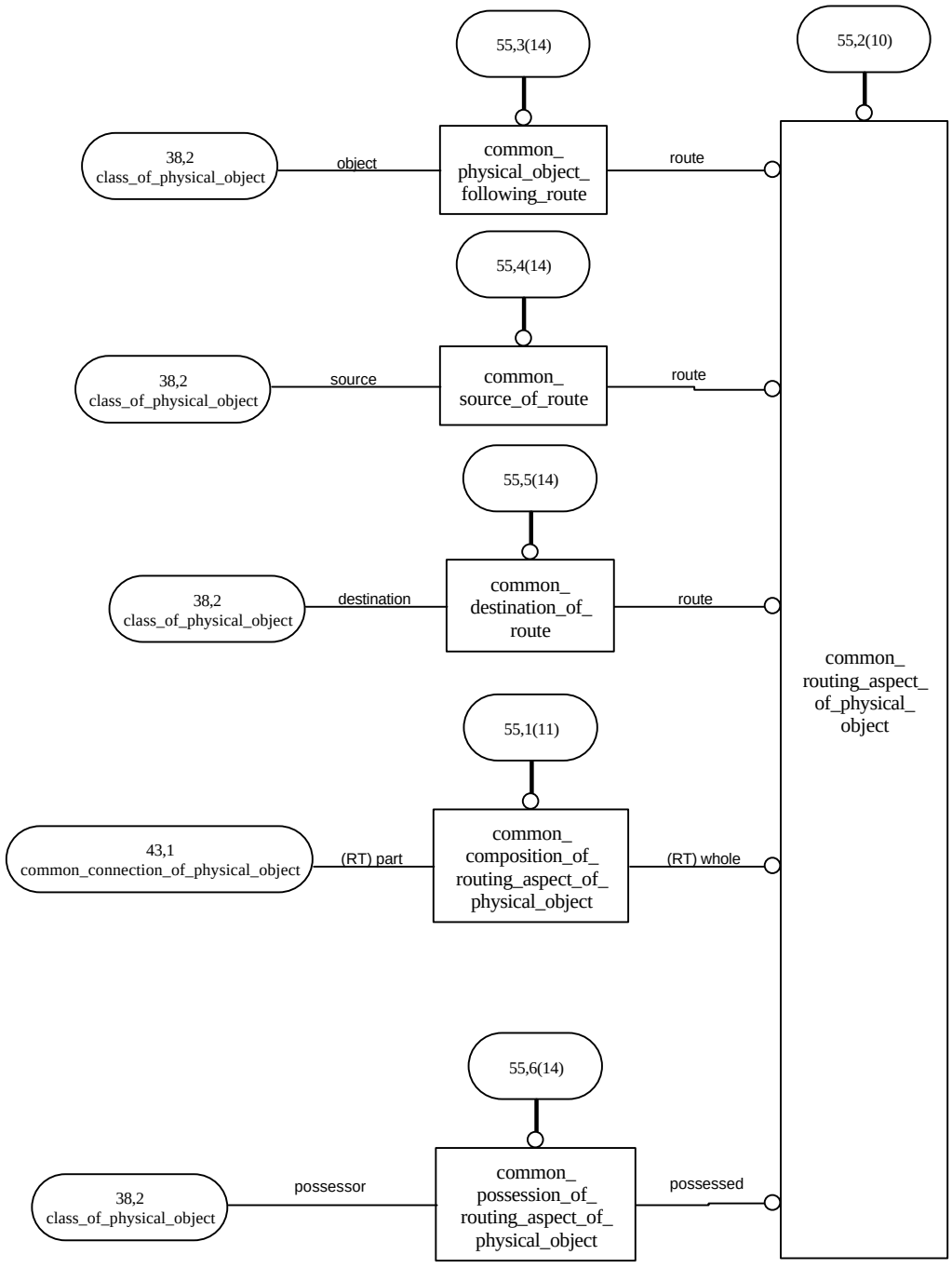


Figure 55 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Common routing aspect of physical object

7.53 Organization

A description of the uses of the entity types shown in this section will go here, eventually.

7.53.1 person_or_organization

A Person_or_organisation is a Person or Organization.

EXPRESS specification:

```
*)
TYPE person_or_organization = SELECT
  (organization,
   person);
END_TYPE;
(*
```

7.53.2 organization

An Organization is a Physical_object that consists of people, functions, equipment, machines, and buildings that are controlled to meet some purpose.

EXAMPLE ISO/SC4 is an Organization.

EXPRESS specification:

```
*)
ENTITY organization
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.53.3 place_of_residence_of_organization

A Place_of_residence_of_organization is a Possessed_association that indicates the Organisation has an office or base or other significant presence at the place Physical_object.

EXAMPLE The relationship between the Organization "Statoil" and the Physical_object "Building at Hamangskogen 60" that indicates the building is an office of Statoil is a Place_of_residence_of_organization.

EXPRESS specification:

```
*)
ENTITY place_of_residence_of_organization
   SUBTYPE OF (possessed_association);
   organization : organization;
   place        : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

organization: The organization specifies the Organization that resides at or occupies the place Physical_object.

place: The place specifies the Physical_object that is occupied by or acts as a residence for the Organization.

7.53.4 representation_of_organization

A representation_of_organization is a Possessed_association that indicates that the Organization is represented by a representing Person or Organization. Here representation means able to act for in some defined capacity.

EXAMPLE The relationship between the Organization "Al Matrouk and Sons" and the Organization "XYZ Co" that indicates that Al Matrouk and Sons may represent the XYZ Co in the sale of XYZ Co goods and services is a Representation_of_organization.

EXPRESS specification:

```
*)
ENTITY representation_of_organization
   SUBTYPE OF (possessed_association);
   represented : organization;
   representing : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

represented: The represented specifies the Organization that is being represented by the representing Person or Organization.

representing: The representing specifies the Person or Organisation that is representing the represented Organisation.

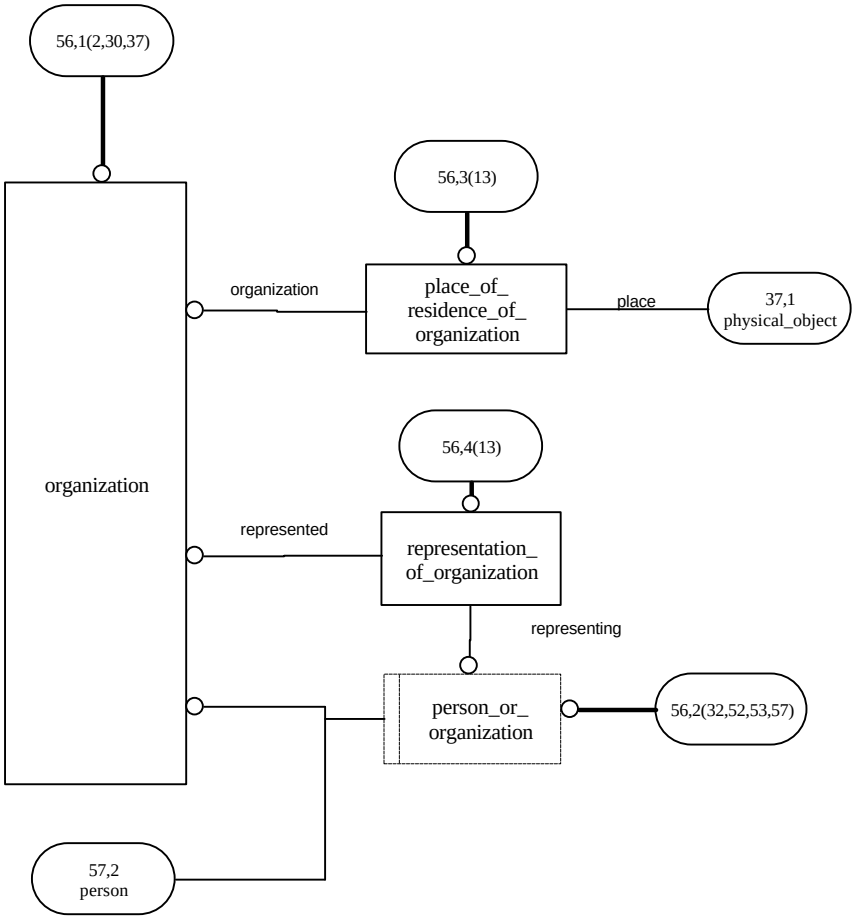


Figure 56 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Organization

7.54 Lifeform and person

A description of the uses of the entity types shown in this section will go here, eventually.

7.54.1 assignment_of_person

An Assignment_of_person is a Possessed_association that indicates that the assignee Person is assigned to the assigner Person or Organization. Assigned means allocated to a position or duty within the organisation.

EXAMPLE The relationship between the Person "Jack Green" and the Organization "Alpha Project" that indicates that Jack Green is assigned to the Alpha Project is an Assignment_of_person.

EXPRESS specification:

```
*)
ENTITY assignment_of_person
   SUBTYPE OF (possessed_association);
   assignee : person;
   assigner : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

assignee: The assignee specifies the Person who is assigned to a duty or position within the assigner Organization.

assigner: The assigner specifies the Person or Organization to which the assignee Person is assigned.

7.54.2 employment_of_person

An Employment_of_person is a Possessed_association that indicates that the employee is employed by the employee Person or Organization. Here employment is meant in the legal sense of there being contract of employment between the employee and employer.

EXAMPLE The relationship between the Person "Jack Green" and the Organization "XYZ Co" indicating that Jack is employed by the XYZ Co. is an Employment_of_person.

EXPRESS specification:

```
*)
ENTITY employment_of_person
   SUBTYPE OF (possessed_association);
   employee : person;
   employer : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

employee: The emploee specifies the Person that is employed by the employer Person or Organization.

employer: The employer specifies the Person or Organization that employs the employee.

7.54.3 lifeform

A Lifeform is a Physical_object that is capable of life.

EXAMPLE 1 A live tree is a Lifeform, whereas a dead tree is not.

EXAMPLE 2 A live person is a Lifeform.

EXPRESS specification:

```
*)
ENTITY lifeform
   SUBTYPE OF (physical_object);
END_ENTITY;
(*
```

7.54.4 person

A Person is a Lifeform of the species Homo Sapiens. The dead body is an Inanimate_physical_object

A Person may have both physical and functional aspects.

EXAMPLE W Shakespeare is a person whose existence has terminated, but can still be referred to.

EXPRESS specification:

```
*)
ENTITY person
   SUBTYPE OF (lifeform);
END_ENTITY;
(*
```

7.54.5 place_of_residence_of_person

A Place_of_residence_of_person is a Possessed_association that indicates the person has an office or home or other enduring presence at the place Physical_object.

EXAMPLE The relationship between the Person "Jack Green" and the Physical_object "Jack's boat" that indicates Jack lives on his boat is a Place_of_residence_of_person.

EXPRESS specification:

```
*)
ENTITY place_of_residence_of_person
   SUBTYPE OF (possessed_association);
   person : person;
   place  : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

person: The person specifies the Person that is resident at the place Physical_object.

place: The place specifies the Physical_object that acts as a place of residence of the person.

7.54.6 representation_of_person

A representation_of_person is a Possessed_association that indicates that the represented Person is represented by a representing Person or Organization. Here representation means able to act for in some defined capacity.

EXAMPLE The relationship between the Mrs Green and her son Jack Green that indicates that Jack has a power of attorney for Mrs Green is a Representation_of_person.

EXPRESS specification:

```
*)
ENTITY representation_of_person
   SUBTYPE OF (possessed_association);
   represented  : person;
   representing : person_or_organization;
END_ENTITY;
(*
```

Attribute definitions:

represented: The represented specifies the Person that is represented by the representing Person or Organization.

representing: The representing specifies the Person or Organization that is representing the represented Person.

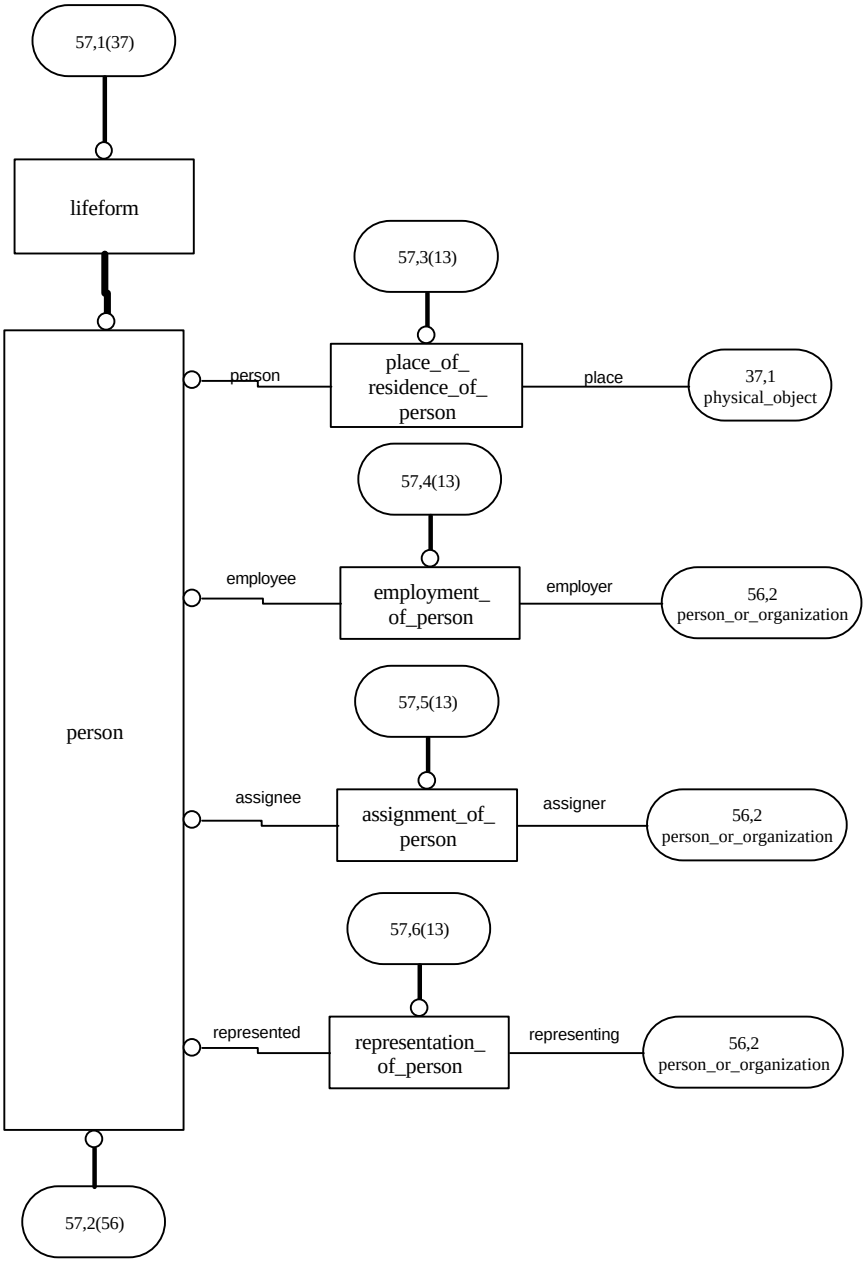


Figure 57 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Lifeform and person

7.55 Information

A description of the uses of the entity types shown in this section will go here, eventually.

7.55.1 description_of_object_via_information

A Description_of_object_via_information is a Possessed_association that indicates the describer Information is information about the described Application_object.

EXAMPLE The relationship between the Information "project plan" and the Activity "project" that indicates the information is about the project is a Description_of_object_via_information.

EXPRESS specification:

```
*)
ENTITY description_of_object_via_information
   SUBTYPE OF (possessed_association);
   described : application_object;
   describer : information;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Application_object that is described in the describer Information.

describer: The describer specifies the Information that forms a description of the described Application_object.

7.55.2 essential_classification_of_information

An Essential_classification_of_information is an Essential_classification_of_individual that indicates the classified Information is a member of the classifier Class_of_information.

EXAMPLE 1 The relationship between the nformation "exploration plan" and Class_of_information "exploration" that indicates the information is about exploration is an Essential_classification_of_information.

EXAMPLE 2 The relationship between the Information "exploration plan" and the Class_of_information "secret" that indicates that the exploration plan information is secret is not an Essential_classification_of_information but is an Incidental_classification_of_individual.

NOTE This is not an essential classification because the information is still the exploration plan information even if it is declassified.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_information
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : information;
   SELF\classification_of_individual.classifier : class_of_information;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Information that is a member of the classifier Class_of_information.

classifier: The classifier specifies the Class_of_information that includes the classified Information as a member.

7.55.3 expression_of_information_by_encoded_information

An Expression_of_information_by_encoded_information is a Possessed_association that indicates the expressed Information is represented by the expressor Encoded_information.

EXAMPLE The relationship between the information of a particular book and the English text of the book indicating the text is an expression or representation of the information is an Expression_of_information_by_encoded_information.

EXPRESS specification:

```
*)
ENTITY expression_of_information_by_encoded_information
   SUBTYPE OF (possessed_association);
   expressed : information;
   expressor : encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

expressed: The expressed specifies the Information that is encoded as the expressor Encoded_information.

expressor: The expressor specifies the Encoded_information that is an encoding of the expressed Information.

7.55.4 information

An Information is an Individual that is something known.

EXPRESS specification:

```
*)
ENTITY information
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.55.5 reference_to_object_within_information

A Reference_to_object_within_information is a Possessed_association that indicates the referencer Information makes reference to the referenced Application_object. The nature of the reference in not specified.

EXAMPLE The relationship between the Information "plan for jacking up the Osprey platform" and the Physical_object "Osprey platform" Application_object indicating the information makes reference to the platform is a Reference_to_object_within_information.

EXPRESS specification:

```
*)
ENTITY reference_to_object_within_information
   SUBTYPE OF (possessed_association);
   referenced : application_object;
   referencer : information;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Application_object that is referred to by the referencer information.

referencer: The referencer specifies the Information that contains a reference to the referenced Application_object.

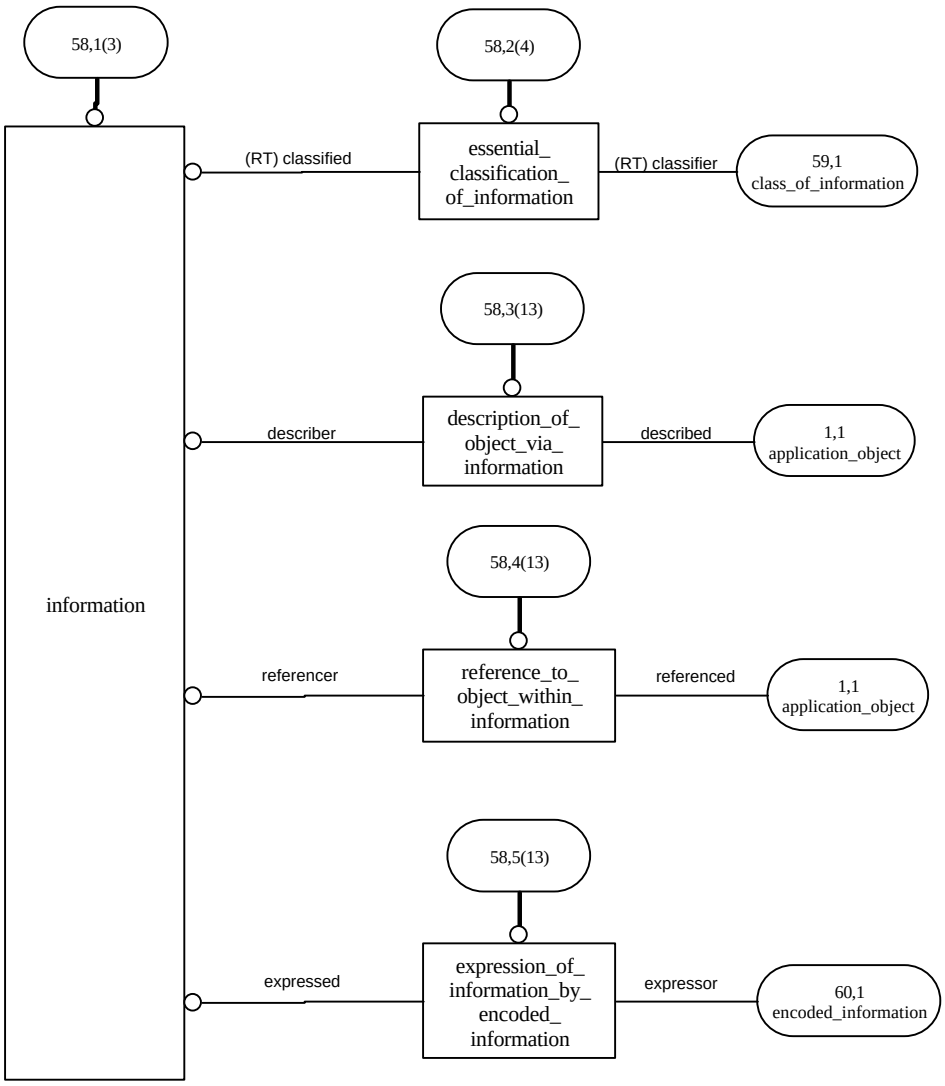


Figure 58 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Information

7.56 Class of information

A description of the uses of the entity types shown in this section will go here, eventually.

7.56.1 class_of_information

A Class_of_information is a Class_of_individual that indicates a common nature of Information.

EXAMPLE 1 Confidential is a Class_of_information.

EXAMPLE 2 Refinery is a Class_of_information.

EXPRESS specification:

```
*)
ENTITY class_of_information
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.56.2 common_description_of_object_via_information

A Common_description_of_object_via_information is a Common_association that is a specialization of Description_of_object_via_information that constrains members of the describer Class_of_information to describe members of the described Class.

EXAMPLE The class of relationship between the Class_of_information "refinery information" and the Class "refinery" that indicates that refinery information is about one or more refineries is a Common_description_of_object_via_information.

EXPRESS specification:

```
*)
ENTITY common_description_of_object_via_information
   SUBTYPE OF (common_association);
   described : class;
   describer : class_of_information;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Class whose members can be described by members of the describer Class_of_information.

The described role corresponds to role_1 of the Common_association cardinality data.

describer: The describer specifies the Class_of_information whose members can describe members of the described Class.

The describer role corresponds to role_2 of the Common_association cardinality data.

7.56.3 common_expression_of_information_by_encoded_information

A Common_expression_of_information_by_encoded_information is a Common_association that is a specialization of Expression_of_information_by_encoded_information that constrains members of the expressed Class_of_information to be expressable by members of the expressor Class_of_encoded_information.

EXAMPLE The class of relationship between the Class_of_information "English Law" and the Class_of_encoded_information "English text" indicating that English law shall be expressed in English text is a Common_expression_of_information_by_encoded_information.

EXPRESS specification:

```
*)
ENTITY common_expression_of_information_by_encoded_information
   SUBTYPE OF (common_association);
   expressed : class_of_information;
   expressor : class_of_encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

expressed: The expressed specifies the Class_of_information whose members can be encoded by members of the expressor Class_of_encoded_information.

The expressed role corresponds to role_1 of the Common_association cardinality data.

expressor: The expressor specifies the Class_of_encoded_information that can be used to encode members of the expressed Class_of_information.

The expressor role corresponds to role_2 of the Common_association cardinality data.

7.56.4 common_reference_to_object_within_information

A Common_reference_to_object_within_information is a Common_association that is a specialization of Reference_to_object_within_information that constrains members of the referencer Class_of_information to reference members of the referenced Class.

EXAMPLE The class of relationship between the Class_of_information "plant maintenance information" and the Class_of_activity "health and safety procedure" indicating that maintenance information must refer to health and safety procedures is a Common_reference_to_object_within_information.

EXPRESS specification:

```
*)
ENTITY common_reference_to_object_within_information
   SUBTYPE OF (common_association);
   referenced : class;
   referencer : class_of_information;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Class whose members can be referenced by members of the referencer Class_of_information.

The referenced role corresponds to role_1 of the Common_association cardinality data.

referencer: The referencer specifies the Class_of_information whose members can make references to members of the referenced Class.

The referencer role corresponds to role_2 of the Common_association cardinality data.

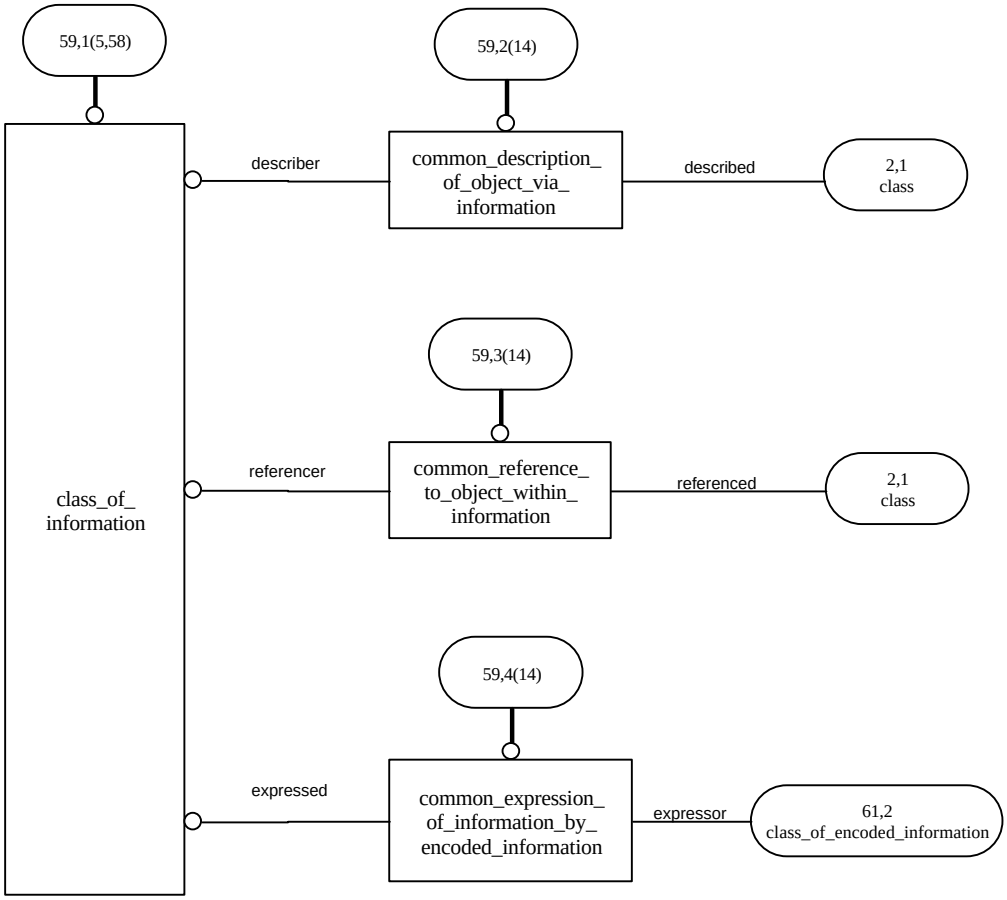


Figure 59 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of information

7.57 Encoded information

A description of the uses of the entity types shown in this section will go here, eventually.

7.57.1 class_of_encoded_information

A Class_of_encoded_information is a Class_of_individual that indicates a common nature of Encoded_information.

EXAMPLE 1 English text is a Class_of_encoded_information.

EXAMPLE 2 Morse code is a Class_of_encoded_information.

EXAMPLE 3 IEEE floating point single precision real number is a Class_of_encoded_information.

EXPRESS specification:

```
*)
ENTITY class_of_encoded_information
   SUBTYPE OF (class_of_individual);
END_ENTITY;
(*
```

7.57.2 description_of_object_by_encoded_information

A description_of_object_by_encoded_information is a Possessed_association that indicates that the information of the describer Encoded_information is about the the described Application_object.

EXAMPLE The relationship between a text and an object described by the information of the text is a description_of_object_by_encoded_information.

EXPRESS specification:

```
*)
ENTITY description_of_object_by_encoded_information
   SUBTYPE OF (possessed_association);
   described : application_object;
   describer : encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

described: The describer specifies the Application_object that is described by information contained by the describer Encoded_information.

describer: The describer specifies the Encoded_information that conveys information that is about the described Application_object.

7.57.3 encoded_information

An Encoded_information is an Individual that is a pattern used to convey information.

EXAMPLE The pattern of this text is an Encoded_information

EXPRESS specification:

```
*)
ENTITY encoded_information
   SUPERTYPE OF (ONEOF (encoded_textual_object,
                        encoded_numeric_object,
                        encoded_placement, binary_object,
                        encoded_date_and_time,
                        encoded_calendar_date,
                        encoded_clock_time))
   SUBTYPE OF (individual);
END_ENTITY;
(*
```

7.57.4 essential_classification_of_encoded_information

An Essential_classification_of_encoded_information is an Essential_classification_of_individual that indicates that the classified Encoded_information is a member of the classifier Class_of_encoded_information.

EXAMPLE The relationship between the Encoded_information that is the pattern of the text of this example and the class_of_encoded_information "English text characters" that indicates the pattern is an English text pattern is an Essential_classification_of_encoded_information.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_encoded_information
   SUBTYPE OF (essential_classification_of_individual);
   SELF\classification_of_individual.classified : encoded_information;
   SELF\classification_of_individual.classifier : class_of_encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Encoded_information that is a member of the classified Class_of_encoded_information.

classifier: The classifier specifies the Class_of_encoded_information that the classified Encoded_information is a member of.

7.57.5 presentation_of_encoded_information_by_physical_object

A Presentation_of_encoded_information_by_physical_object is a Possessed_association that indicates the presented Encoded_information is presented in a form such that the pattern can be observed from the properties or behaviour of the presented Physical_object.

EXAMPLE The relationship between the text encoding of this example and the paper or screen you are reading from is a Presentation_of_encoded_information_by_physical_object.

EXPRESS specification:

```
*)
ENTITY presentation_of_encoded_information_by_physical_object
   SUBTYPE OF (possessed_association);
   presented : encoded_information;
   presenter : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

presented: The presented specifies the Encoded_information that is presented by the presenter Physical_object.

presenter: The presenter specifies the Physical_object whose properties or behaviour exhibit the pattern of the presented Encoded_information.

7.57.6 reference_to_object_within_encoded_information

A Reference_to_object_within_encoded_information is a Possessed_association that indicates the referencer Encoded_information conveys information that includes reference to the referenced Application_object.

EXAMPLE The relationship between The Encoded_information that is the text of the ISO 15926 working draft document and the Information that is the ISO 10303 standard indicating that working draft text contains a reference to the ISO 10303 standard is a Reference_to_object_within_encoded_information.

EXPRESS specification:

```
*)
ENTITY reference_to_object_within_encoded_information
   SUBTYPE OF (possessed_association);
   referenced : application_object;
   referencer : encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Application_object that is referenced by the information encoded in the referencer Encoded_information.

referencer: The referencer specifies the Encoded_information that contains the reference to the Application_object.

7.57.7 symbolization_of_object_by_encoded_information

A Symbolization_of_object_by_encoded_information is a Possessed_association that indicates the pattern of the symbolizer Encoded_information stands for or is a sign for the symbolized Application_object.

EXAMPLE The relationship between the text "USA government" and the Organization of that name is a Symbolization_of_object_by_encoded_information.

EXPRESS specification:

```
*)
ENTITY symbolization_of_object_by_encoded_information
   SUBTYPE OF (possessed_association);
   symbolized : application_object;
   symbolizer : encoded_information;
END_ENTITY;
(*
```

Attribute definitions:

symbolized: The symbolized specifies the Application_object that the symbolizer Encoded_information stands for.

symbolizer: The symbolizer specifies the Encoded_information that stands for the symbolized Application_object.

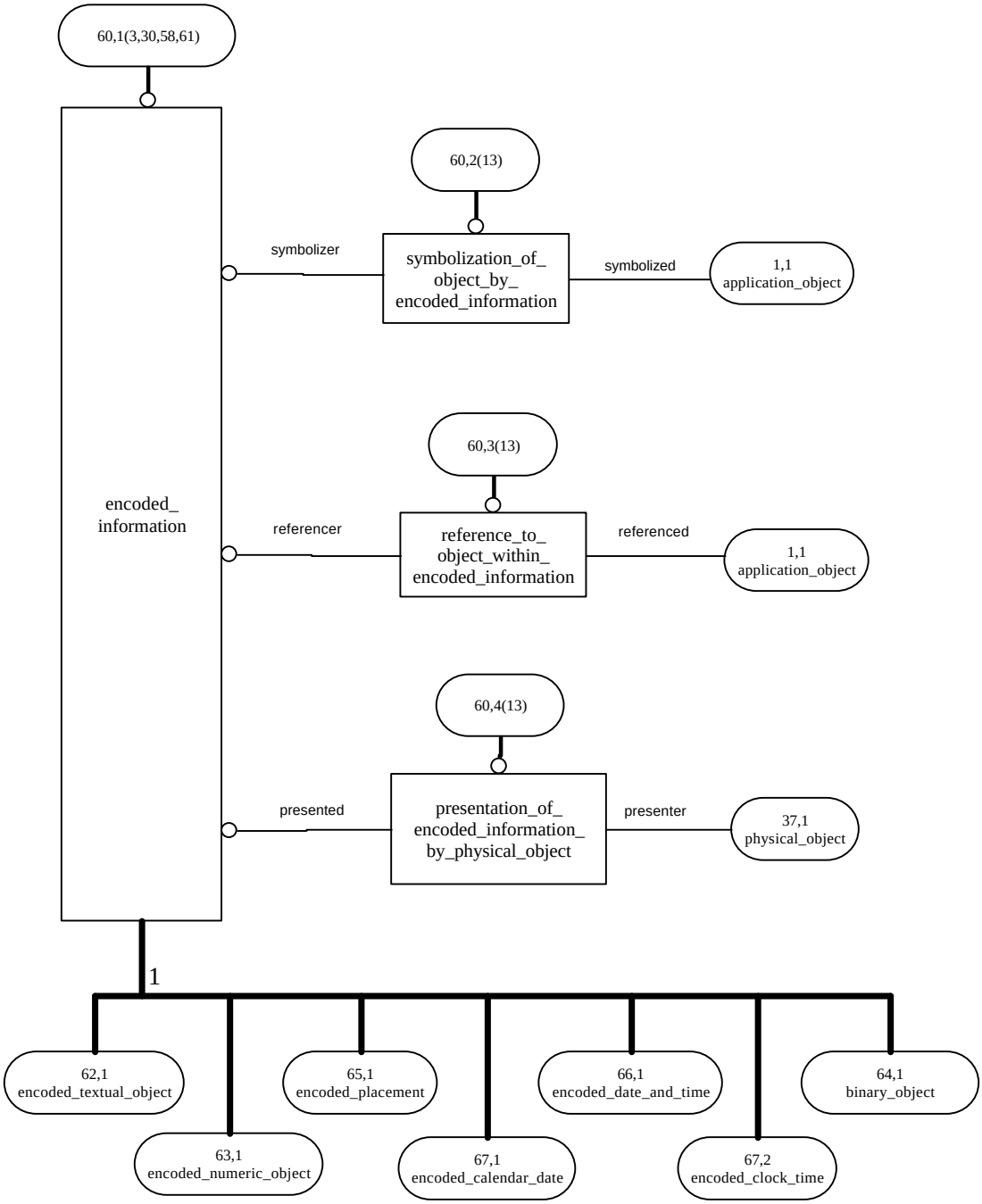


Figure 60 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded information (1 of 2)

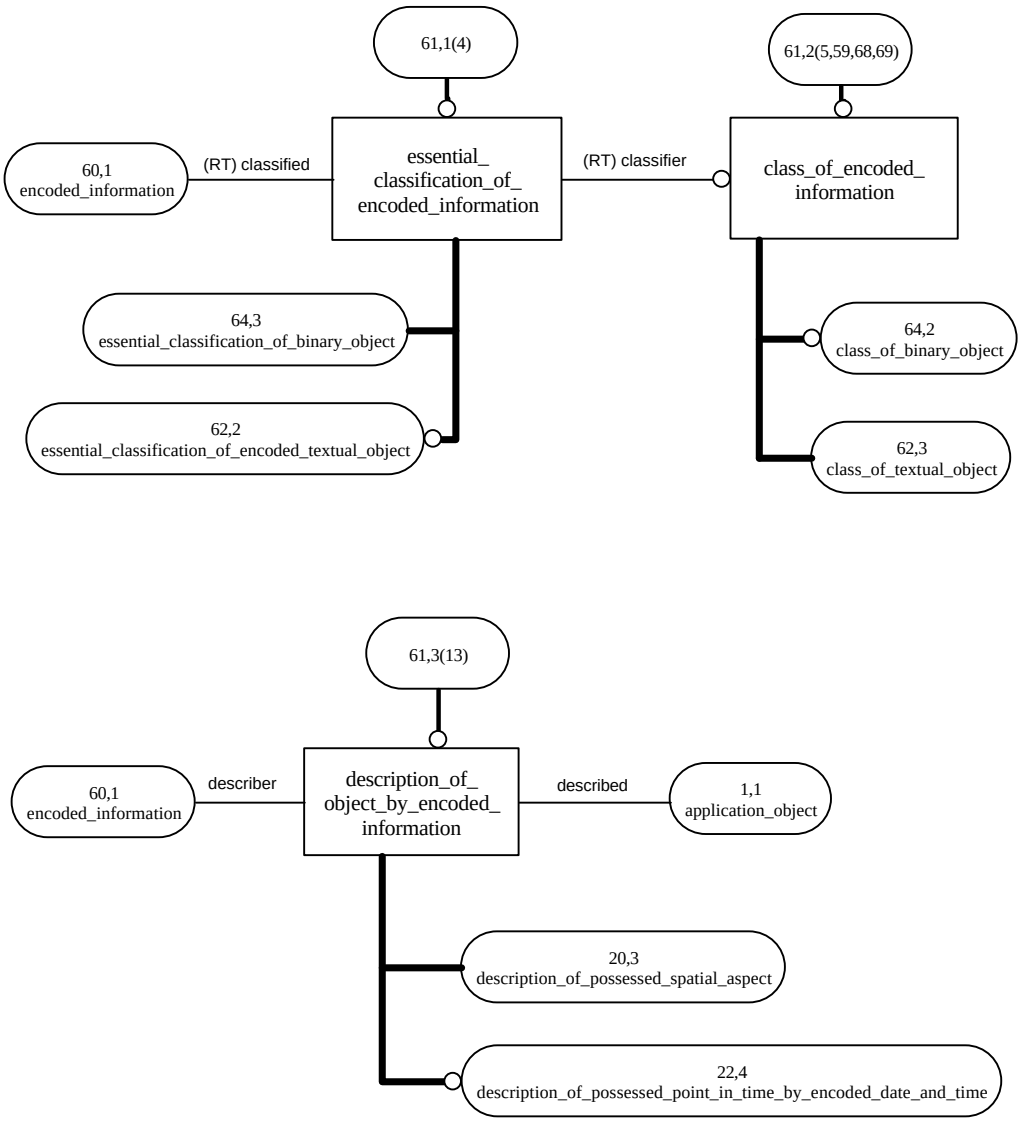


Figure 61 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded information (2 of 2)

7.58 Encoded textual information

A description of the uses of the entity types shown in this section will go here, eventually.

7.58.1 class_of_textual_object

A Class_of_textual_object is a Class_of_encoded_information that indicates a common nature of Encoded_textual_object.

EXAMPLE Encoded_textual_objects that begin with "a" is a Class_of_textual_object.

EXAMPLE 2 English text is a Class_of_textual_object.

EXPRESS specification:

```
*)
ENTITY class_of_textual_object
   SUBTYPE OF (class_of_encoded_information);
END_ENTITY;
(*
```

7.58.2 composition_of_concatenation_aspect_of_encoded_textual_object

A Composition_of_concatenation_aspect_of_encoded_textual_object is a Composition_of_possessed_aspect that indicates the part Concatenation_of_textual_object is a part of the whole Possessed_concatenation_aspect_of_encoded_textual_object.

EXAMPLE The relationship between the Concatenation_of_textual_object (the,man) and the Possessed_concatenation_aspect_of_encoded_textual_object that is the ordering (the, man, read, the ,book) is a Composition_of_concatenation_aspect_of_encoded_textual_object.

EXPRESS specification:

```
*)
ENTITY composition_of_concatenation_aspect_of_encoded_textual_object
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part : concatenation_of_textual_object;
   SELF\composition_of_possessed_aspect.whole :
      possessed_concatenation_aspect_of_encoded_textual_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Concatenation_of_textual_object that is part of the whole possessed concatenation aspect.

whole: The whole specifies the Possessed_concatenation_aspect_of_encoded_textual_object that is the whole for the part Concatenation_of_textual_object.

7.58.3 concatenation_of_textual_object

A concatenation_of_textual_object is a Possessed_association that indicates that the predecessor Encoded_textual_object comes before the successor Encoded_textual_object.

EXAMPLE. The relationship that indicates "a" precedes "book" is a concatenation_of_textual_object.

NB This example shows the need to distinguish between occurrences of "a" and the class "a". The "a" on my page is different to the "a" on your page, but they are both a.

EXPRESS specification:

```
*)
ENTITY concatenation_of_textual_object
   SUBTYPE OF (possessed_association);
   predecessor : encoded_textual_object;
   successor   : encoded_textual_object;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Encoded_textual_object that comes before the successor Encoded_textual_object.

successor: The successor specifies the Encoded_textual_object that follows the predecessor Encoded_textual_object.

7.58.4 encoded_textual_object

An Encoded_textual_object is an Encoded_information where the pattern is a sequence of one or more ISO 10646 characters.

EXAMPLE 1 The string "zpla" is an Encoded_textual_object.

EXAMPLE 2 The string "17a. brl" is an Encoded_textual_object.

EXPRESS specification:

```
*)
ENTITY encoded_textual_object
   SUBTYPE OF (encoded_information);
   content : STRING;
END_ENTITY;
(*
```

Attribute definitions:

content: The content specifies a sequence of one or more ISO 10646 characters.

7.58.5 essential_classification_of_encoded_textual_object

An Essential_classification_of_encoded_textual_object is an Essential_classification_of_encoded_information that indicates the classified Encoded_textual_object is a member of the classifier Class_of_textual_object.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_encoded_textual_object
   SUBTYPE OF (essential_classification_of_encoded_information);
   SELF\essential_classification_of_encoded_information.classified :
      encoded_textual_object;
   SELF\essential_classification_of_encoded_information.classifier :
      class_of_textual_object;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies the Encoded_textual_object that is a member of the classifier Class_of_textual_object.

classifier: The classifier specifies the Class_of_textual_object that the classified Encoded_textual_object is a member of.

7.58.6 possessed_concatenation_aspect_of_encoded_textual_object

A Possessed_concatenation_aspect_of_encoded_textual_object is a Possessed_aspect that is a particular ordering of the parts of an Encoded_textual_object. The ordering is defined as a set of Concatenation_of_textual_object relationships.

EXAMPLE The ordering of the words (book, man, the,a, read) that is the man read a book is a Possessed_concatenation_aspect_of_encoded_textual_object that consists of the Concatenation_of_textual_object relationships (the,man), (man,read) (read,a), (a,book).

EXPRESS specification:

```
*)
ENTITY possessed_concatenation_aspect_of_encoded_textual_object
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : encoded_textual_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Encoded_textual_object that possesses the concatenation aspect.

7.58.7 replacement_of_textual_object

A replacement_of_textual_object is a Possessed_association that indicates that the replaced Encoded_textual_object is replaced by the replacer Encoded_textual_object.

Note. This makes no sense to me. It says for example a is replaced by b. Need to distinguish between occurrence and class. An occurrence of a is replaced by an occurence of b does make sense.

EXPRESS specification:

```
*)
ENTITY replacement_of_textual_object
   SUBTYPE OF (possessed_association);
   replaced : encoded_textual_object;
   replacer : encoded_textual_object;
END_ENTITY;
(*
```

Attribute definitions:

replaced: The replaced specifies the Encoded_textual_object that is replaced by the replacer Encoded_textual_object.

replacer: The replacer specifies the Encoded_textual_object that replaces the replaced Encoded_textual_object.

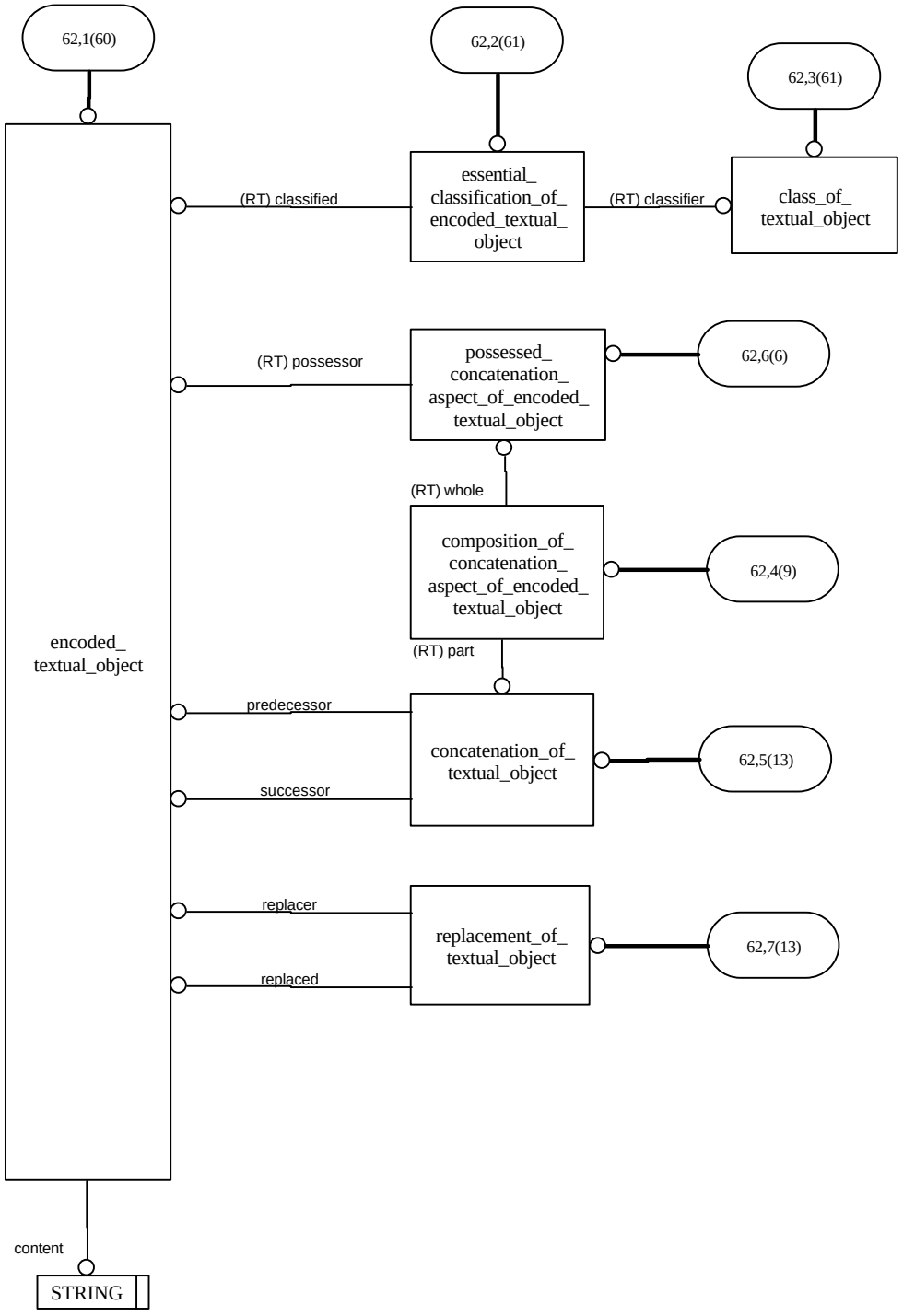


Figure 62 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded textual information

7.59 Encoded numeric object

A description of the uses of the entity types shown in this section will go here, eventually.

7.59.1 encoded_numeric_list

An Encoded_numeric_list is an Encoded_numeric_object where the pattern is a list of numbers.

EXPRESS specification:

```
*)
ENTITY encoded_numeric_list
   SUBTYPE OF (encoded_numeric_object);
   content : LIST [1:?] OF NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

content: The content specifies the list of numbers.

7.59.2 encoded_numeric_object

An Encoded_numeric_object is an Encoded_information where the pattern is a number. a range of numbers, or a list of numbers.

EXPRESS specification:

```
*)
ENTITY encoded_numeric_object
   ABSTRACT SUPERTYPE OF (ONEOF (numeric_point,
                                 numeric_range_by_tolerance,
                                 encoded_numeric_list,
                                 numeric_range_by_bounds))
   SUBTYPE OF (encoded_information);
END_ENTITY;
(*
```

7.59.3 numeric_point

A Numeric_point is an Encoded_numeric_object that is a pattern for a single number.

EXPRESS specification:

```
*)
ENTITY numeric_point
   SUBTYPE OF (encoded_numeric_object);
   number_value : NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

number_value: The number_value specifies the single number.

7.59.4 numeric_range_by_bounds

A Numeric_range_by_bounds is an Encoded_numeric_object that is the range of numbers

EXPRESS specification:

```
*)
ENTITY numeric_range_by_bounds
   SUBTYPE OF (encoded_numeric_object);
   lower_bound : NUMBER;
   upper_bound : NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

lower_bound: The lower bound of the number range

upper_bound: The upper bound of the number range.

7.59.5 numeric_range_by_tolerance

A Numeric_range_by_tolerance is a pattern that defines a range of numbers where the lower bound of the range is pivot - delta_minus and the upper bound is the pivot + delta_plus.

EXPRESS specification:

```
*)
ENTITY numeric_range_by_tolerance
   SUBTYPE OF (encoded_numeric_object);
   delta_minus : NUMBER;
   delta_plus  : NUMBER;
   pivot       : NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

delta_minus: The delta_minus specifies the difference between the range pivot and the lower limit of the range.

Delta_minus shall be a positive number.

delta_plus: The delta_plus specifies the difference between the range pivot and the upper limit of the range.

Delta_plus shall be a positive number.

pivot: The pivot specifies a number within the range that is delta_plus from the upper limit of the range and delta_minus from the lower limit of the range.

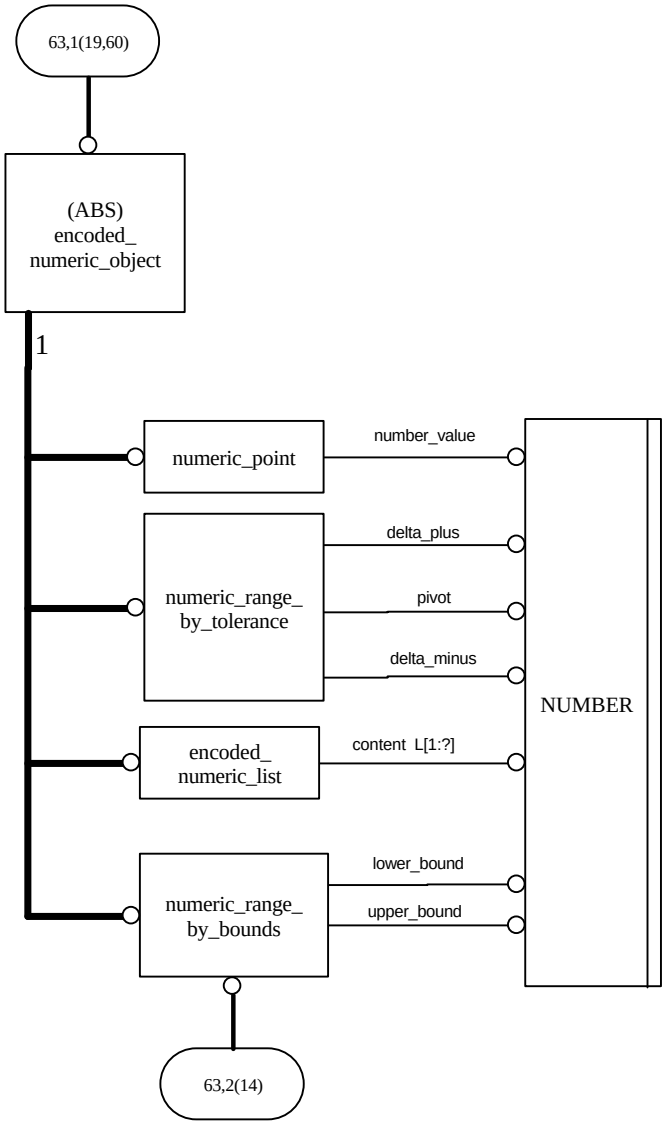


Figure 63 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded numeric object

7.60 Encoded phonic object

This section is deliberately omitted.

7.61 Binary object

A description of the uses of the entity types shown in this section will go here, eventually.

7.61.1 binary_object

A Binary_object is an Encoded_information where the pattern is a sequence of one of two alternative states.

A particular sequence is recorded as a EXPRESS Binary type.

EXPRESS specification:

```
*)
ENTITY binary_object
   SUBTYPE OF (encoded_information);
   content : BINARY;
END_ENTITY;
(*
```

Attribute definitions:

content: The content specifies a particular binary sequence.

7.61.2 class_of_binary_object

A Class_of_binary_object is a Class_of_encoded_information that indicates a common nature of Binary_object members.

EXAMPLE A byte, meaning a sequence of 8 binary states, is a Class_of_binary_object.

EXPRESS specification:

```
*)
ENTITY class_of_binary_object
   SUBTYPE OF (class_of_encoded_information);
END_ENTITY;
(*
```

7.61.3 composition_of_concatenation_aspect_of_binary_object

A Composition_of_concatenation_aspect_of_binary_object is a Composition_of_possessed_aspect that indicates the part Concatenation_of_binary_object is a part of the whole Possessed_concatenation_aspect_of_binary_object.

EXAMPLE The relationship that indicates the Concatenation_of_binary_object [A-B] is a part of the a particular ordering of the Binary_object that consists of parts A and B is a Composition_of_concatenation_aspect_of_binary_object

EXPRESS specification:

```
*)
ENTITY composition_of_concatenation_aspect_of_binary_object
   SUBTYPE OF (composition_of_possessed_aspect);
   SELF\composition_of_possessed_aspect.part : concatenation_of_binary_object;
   SELF\composition_of_possessed_aspect.whole :
      possessed_concatenation_aspect_of_binary_object;
END_ENTITY;
(*
```

Attribute definitions:

part: The part specifies the Concatenation_of_binary_object that is a part of the whole Possessed_concatenation_aspect_of_binary_object.

whole: The whole specifies the Possessed_concatenation_aspect_of_binary_object that is the whole for the part Concatenation_of_binary_object.

7.61.4 concatenation_of_binary_object

A Concatenation_of_binary_object is a Possessed_association that indicates that the predecessor Binary_object comes before the successor Binary_object in one or more orderings or sequences. The sequences in which this is so are indicated by the Possessed_concatenation_aspect_of_binary_object of which the Concatenation_of_binary_object is a part.

EXAMPLE The relationship between Binary_object "A" and Binary_object "B" indicating that A follows B in a sequence is a Concatenation_of_binary_object.

EXPRESS specification:

```
*)
ENTITY concatenation_of_binary_object
   SUBTYPE OF (possessed_association);
   predecessor : binary_object;
   successor   : binary_object;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: The predecessor specifies the Binary_object that comes before the successor Binary_object.

successor: The successor specifies the Binary_object that comes after the predecessor Binary_object.

7.61.5 essential_classification_of_binary_object

An Essential_classification_of_binary_object is an Essential_classification_of_encoded_information that indicates that the classified Binary_object is a member of the classifier Class_of_binary_object.

EXAMPLE The relationship between the Binary_object A and the Class_of_binary_object "Byte" that indicates that A is always a sequence of 8 binary states is an Essential_classification_of_binary_object.

EXPRESS specification:

```
*)
ENTITY essential_classification_of_binary_object
   SUBTYPE OF (essential_classification_of_encoded_information);
   SELF\essential_classification_of_encoded_information.classified : binary_object;
   SELF\essential_classification_of_encoded_information.classifier :
      class_of_binary_object;
END_ENTITY;
(*
```

Attribute definitions:

classified: The classified specifies tha Binary_object that is a member of the classifier Class_of_binary_object.

classifier: The classifier specifies the Class_of_binary_object that the classified Binary_object is a member of.

7.61.6 possessed_concatenation_aspect_of_binary_object

A Possessed_concatenation_aspect_of_binary_object is a Possessed_aspect that is an ordering of the parts of the possessed Binary_object. The ordering is specified as a composition of Concatenation_of_binary_object relationships.

EXAMPLE The ordering of Binary_object parts A,B,C that is [A-B], [B-C] is a Possessed_concatenation_aspect_of_binary_object, where [A-B] and [B-C] are Concatenation_of_binary_object relationships linking A to B and B to C.

EXPRESS specification:

```
*)
ENTITY possessed_concatenation_aspect_of_binary_object
   SUBTYPE OF (aspect_possessed_by_individual);
   SELF\aspect_possessed_by_individual.possessor : binary_object;
END_ENTITY;
(*
```

Attribute definitions:

possessor: The possessor specifies the Binary_object that possesses the Possessed_concatenation_aspect_of_binary_object.

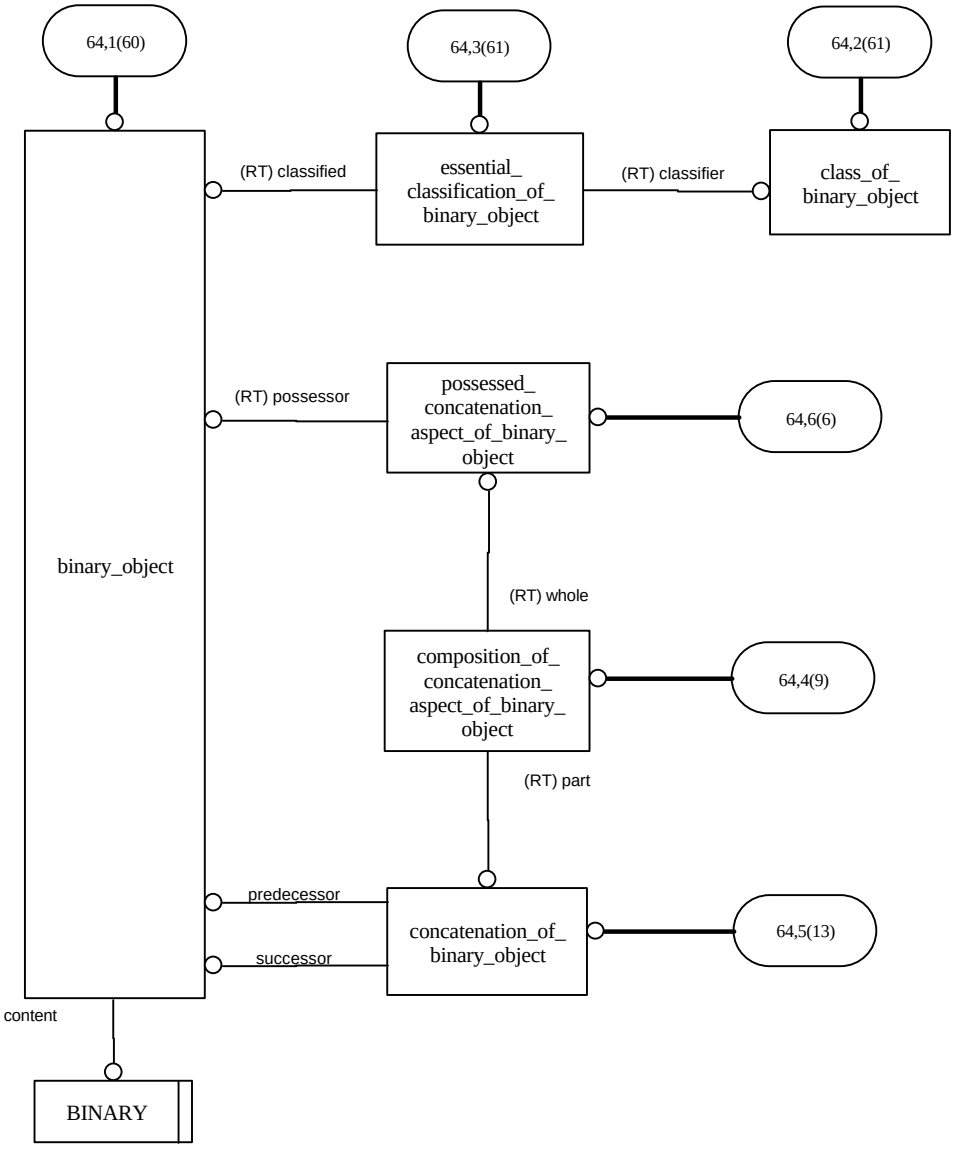


Figure 64 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Binary object

7.62 Encoded placement

A description of the uses of the entity types shown in this section will go here, eventually.

7.62.1 encoded_axis_placement_2d

Definitions of this entity type are not yet available.

EXPRESS specification:

```
*)
ENTITY encoded_axis_placement_2d
   SUBTYPE OF (encoded_placement);
   axis_1 : LIST [1:?] OF NUMBER;
END_ENTITY;
(*
```

7.62.2 encoded_axis_placement_3d

Definitions of this entity type are not yet available.

EXPRESS specification:

```
*)
ENTITY encoded_axis_placement_3d
   SUBTYPE OF (encoded_placement);
   axis_1 : LIST [1:?] OF NUMBER;
   axis_2 : LIST [1:?] OF NUMBER;
END_ENTITY;
(*
```

7.62.3 encoded_placement

An Encoded_placement is an Encoded_information where the pattern is a list of numbers denoting the co-ordinates of a point in space. The co-ordinate system may be indicated by the subtypes!

This is an unfinished proposal.

EXPRESS specification:

```
*)
ENTITY encoded_placement
   SUPERTYPE OF (ONEOF (encoded_axis_placement_2d,
                        encoded_axis_placement_3d))
   SUBTYPE OF (encoded_information);
   location : LIST [1:?] OF NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

location: The location specifies the list of coordinate values of the location.

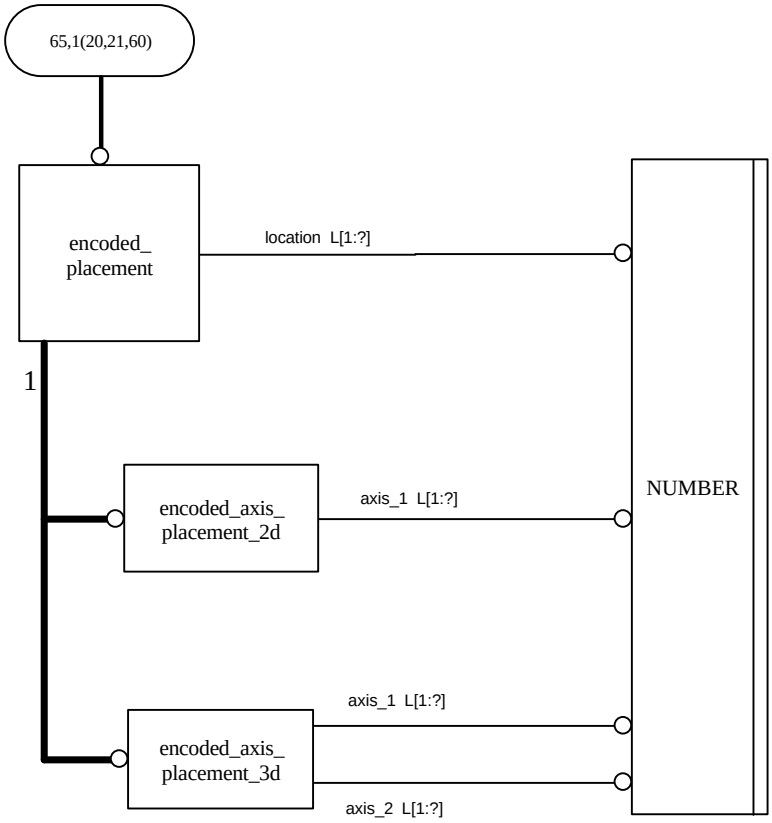


Figure 65 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded placement

7.63 Encoded date and time

A description of the uses of the entity types shown in this section will go here, eventually.

7.63.1 encoded_calendar_date

An encoded_calendar_date is an Encoded_information that conveys a date according to the Gregorian calendar.

NOTE The time zone of the date may be given by reference to the zone offset from GMT (UTC).

EXPRESS specification:

```
*)
ENTITY encoded_calendar_date
   SUBTYPE OF (encoded_information);
   year_of_date            : INTEGER;
   month_of_year           : INTEGER;
   day_of_month            : INTEGER;
   offset_from_GMT_hour    : OPTIONAL INTEGER;
   offset_from_GMT_minutes : OPTIONAL INTEGER;
END_ENTITY;
(*
```

Attribute definitions:

year_of_date: The year of the date.

month_of_year: The month of the year, specified as an integer number between 1 and 12.

day_of_month: The day of the month, specified as an integer number from 1 to 31.

offset_from_GMT_hour: The hour component of the date time zone offset from Greenwich Mean Time, specified as an integer within the range -12 to + 12.

offset_from_GMT_minutes: The minute component of the date time zone offset from Greenwich Mean Time, specified as an integer within the range 0 to 60. The sign sense of the minute is that of the hour component.

7.63.2 encoded_clock_time

An encoded_clock_time is an Encoded_information that conveys a time according to the 24 hour clock.

The seconds must be specified either as an integer or as real number. The precision that may be given for seconds depends on the implementation of real numbers.

Note that the time zone offset of the time may be given and is defined by reference to GMT (UTC).

EXPRESS specification:

```
*)
ENTITY encoded_clock_time
   SUBTYPE OF (encoded_information);
   hour_of_day             : INTEGER;
   minute_of_hour          : INTEGER;
   offset_from_GMT_hour    : OPTIONAL INTEGER;
   offset_from_GMT_minute  : OPTIONAL INTEGER;
   second_of_minute        : NUMBER;
END_ENTITY;
(*
```

Attribute definitions:

hour_of_day: The hour of day, specified as an integer number between 0 and 24.

minute_of_hour: The minute of the hour, specified as an integer number between 0 and 60.

offset_from_GMT_hour: The hour component of the offset of the time from Greenwich Mean Time, specified as an integer within the range -12 to + 12.

offset_from_GMT_minute: The minute component of the offset of the time from Greenwich Mean Time, specified as an integer within the range 0 to 60. The sign sense of the minute is that of the hour component.

second_of_minute: The second of the minute specified as an integer or real number, between 0 and 60.

7.63.3 encoded_date_and_time

An encoded_date_and_time is an Encoded_information that conveys a date and time according to the Gregorian calendar.

Seconds are optionally specified as an integer or real number. The precision that may be given for seconds depends on the implementation of real numbers.

Note that the time zone offset of the date and time may be given and is defined by reference to GMT (UTC).

EXPRESS specification:

```
*)
ENTITY encoded_date_and_time
   SUBTYPE OF (encoded_information);
   year_of_date            : INTEGER;
   month_of_year           : INTEGER;
   day_of_month            : INTEGER;
   hour_of_day             : INTEGER;
   minute_of_hour          : INTEGER;
   second_of_minute        : OPTIONAL NUMBER;
   offset_from_GMT_hour    : OPTIONAL INTEGER;
   offset_from_GMT_minutes : OPTIONAL INTEGER;
END_ENTITY;
(*
```

Attribute definitions:

year_of_date: The year of the date.

month_of_year: The month of the year, specified as an integer number between 1 and 12.

day_of_month: The day of the month, specified as an integer number from 1 to 31.

hour_of_day: The hour of day, specified as an integer number between 0 and 24.

minute_of_hour: The minute of the hour, specified as an integer number between 0 and 60.

second_of_minute: The second of the minute specified as an integer or real number, between 0 and 60.

offset_from_GMT_hour: The hour component of the offset of the date and time from Greenwich Mean Time, specified as an integer within the range -12 to + 12.

offset_from_GMT_minutes: The minute component of the offset of the date and time from Greenwich Mean Time, specified as an integer within the range 0 to 60. The sign sense of the minute is that of the hour component.

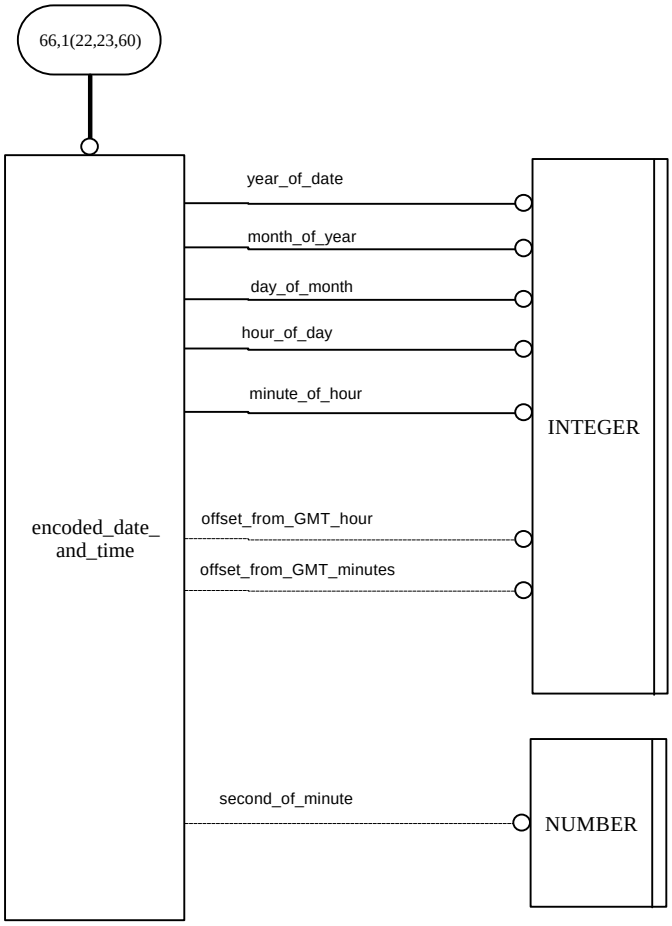


Figure 66 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded date and time (1 of 2)

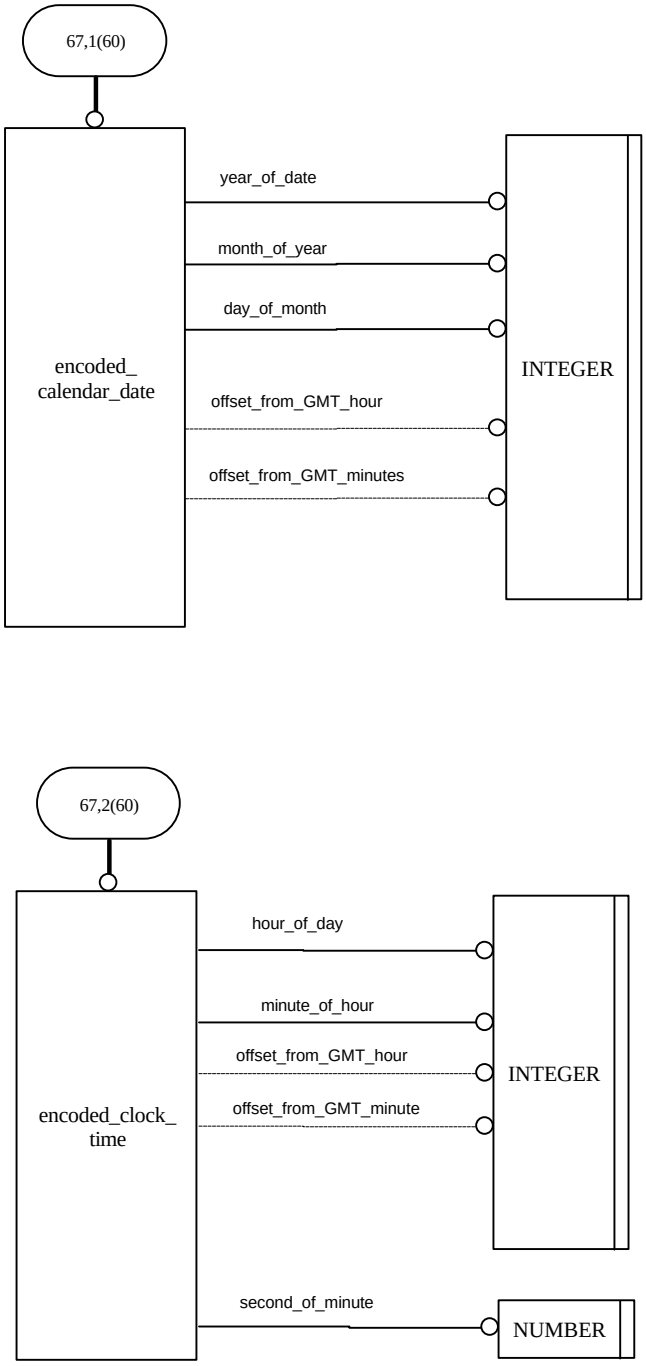


Figure 67 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Encoded date and time (1 of 2)

7.64 Information presenter

A description of the uses of the entity types shown in this section will go here, eventually.

7.64.1 description_of_object_via_physical_object

A Description_of_object_via_physical_object is a Possessed_association that indicates the describer Physical_object possesses some pattern that is interpretable as information about the described Application_object.

EXAMPLE The relationship between the Physical_object "inspection certificate of pump 1234" and the Physical_object "pump #1234" indicating that the certificate has information describing the pump is a Description_of_object_via_physical_object.

EXPRESS specification:

```
*)
ENTITY description_of_object_via_physical_object
   SUBTYPE OF (possessed_association);
   described : application_object;
   describer : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Application_object that is described by information held by the describer Physical_object.

describer: The describer specifies the Physical_object whose properties or state may be interpreted as information about the described Application_object.

7.64.2 presentation_of_class_of_encoded_information_by_physical_object

A Presentation_of_class_of_encoded_information_by_physical_object is a Common_association that is a specialization of presentation_of_encoded_information_by_physical_object that constrains the presenter Physical_object to present members of the presented Class_of_encoded_information.

EXAMPLE The class of relationship between the Physical_object "this floppy disk" and the Class_of_encoded_information "binary encoded information" that indicates the disk holds binary data is a Presentation_of_class_of_encoded_information_by_physical_object.

EXPRESS specification:

```
*)
ENTITY presentation_of_class_of_encoded_information_by_physical_object
   SUBTYPE OF (common_association);
   presented : class_of_encoded_information;
   presenter : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

presented: The presented specifies the Class_of_encoded_information whose members may be presented by the presenter Physical_object.

The presented role corresponds to role_1 of the Common_association cardinality data.

presenter: The presenter specifies the Physical_object that presents members of the presented Class_of_encoded_information.

The presenter role corresponds to role_2 of the Common_association cardinality data.

7.64.3 reference_between_information_presenters

A Reference_between_information_presenters is a Reference_to_object_within_physical_object where the referenced Application_object is a Physical_object.

EXPRESS specification:

```
*)
ENTITY reference_between_information_presenters
   SUBTYPE OF (reference_to_object_within_physical_object);
   SELF\reference_to_object_within_physical_object.referenced : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Physical_object that is referred to by the information of the referencer Physical_object.

7.64.4 reference_to_object_within_physical_object

A Reference_to_object_within_physical_object is a Possessed_association that indicates that the referencer Physical_object possesses properties or state that can be interpreted as information that refers to the referenced Application_object.

EXAMPLE The relationship between the Physical_object "Pump safety certificate" and the Physical_object "pump" indicating the certificate references the pump is a Reference_to_object_within_physical_object.

EXPRESS specification:

```
*)
ENTITY reference_to_object_within_physical_object
   SUBTYPE OF (possessed_association);
   referenced : application_object;
   referencer : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Application_object that the information conveyed by the referencer Physical_object makes reference to.

referencer: The referencer specifies the physical_object whose properties or behaviour convey information that references the referenced Application_object.

7.64.5 symbolization_of_object_by_physical_object

A Symbolization_of_object_by_physical_object is a Possessed_association that indicates the symbolizer Physical_object stands for the symbolized Application_object.

EXAMPLE The relationship between the ink and paper Physical_object "this bar symbol" and the Activity "project task X" indicating the bar symbol depicts the project task X is a symbolization_of_object_by_physical_object.

EXPRESS specification:

```
*)
ENTITY symbolization_of_object_by_physical_object
   SUBTYPE OF (possessed_association);
   symbolized : application_object;
   symbolizer : physical_object;
END_ENTITY;
(*
```

Attribute definitions:

symbolized: The symbolized specifies the Application_object that the symbolizer Physical_object stands for.

symbolizer: The symbolizer specifies the Physical_object that stands for the symbolized Application_object.

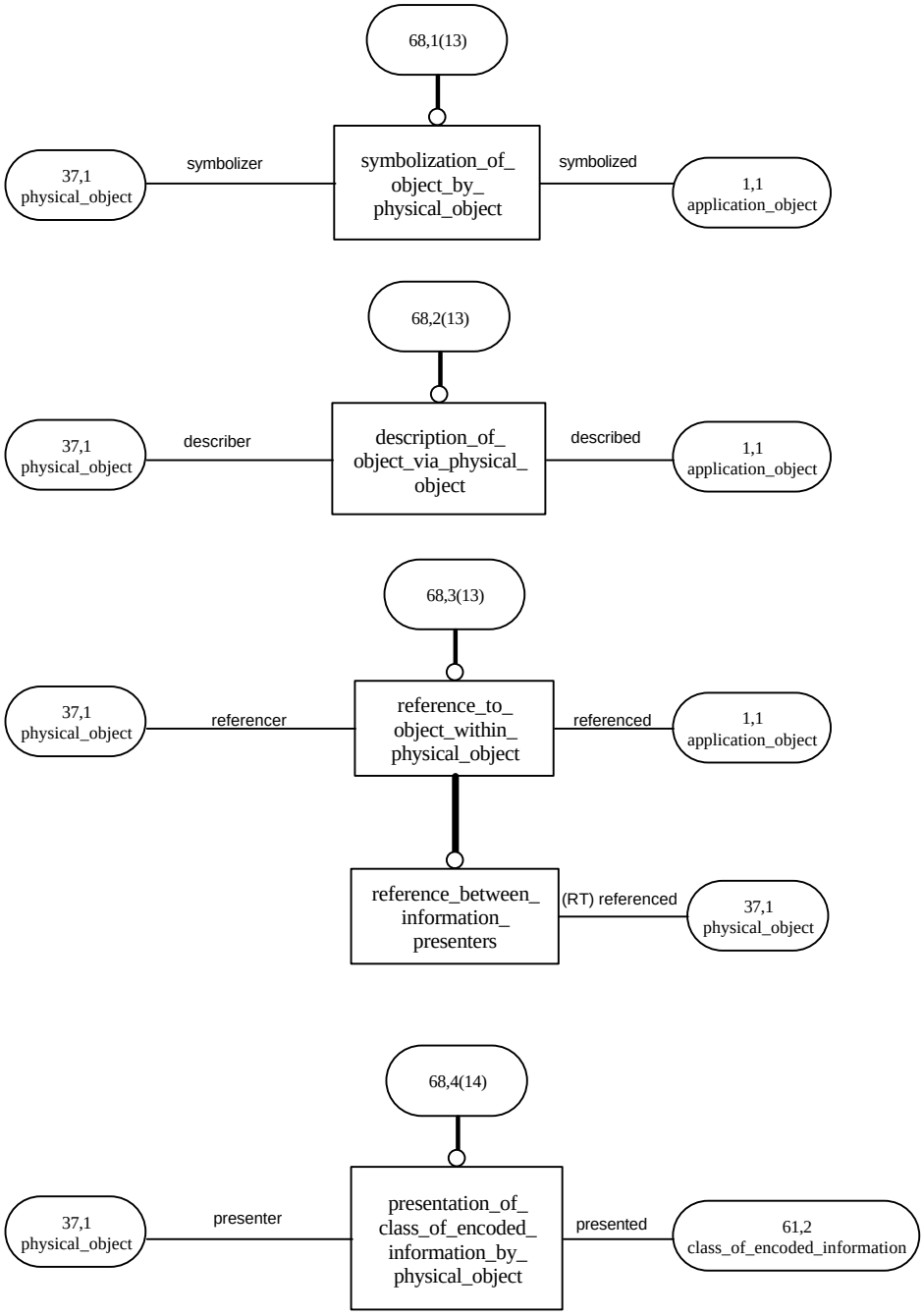


Figure 68 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Information presenter

7.65 Class of information presenter

A description of the uses of the entity types shown in this section will go here, eventually.

7.65.1 common_description_of_object_via_physical_object

A Common_description_of_object_via_physical_object is a Common_association that is a specialization of Description_of_object_via_physical_object that constrains members of the described class to be described by information carried by members of the referencer Class_of_physical_object.

EXAMPLE The class of relationship between the Class "offshore electrical equipment" and the Class_of_physical_object "safety certificate" that indicate that any offshore electrical equipment must have a safety certificate is a Common_description_of_object_via_physical_object.

EXPRESS specification:

```
*)
ENTITY common_description_of_object_via_physical_object
   SUBTYPE OF (common_association);
   described : class;
   describer : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

described: The described specifies the Class whose members may be described by information held on members of the describer Class_of_physical_object.

The described role corresponds to role_1 of the Common_association cardinality data.

describer: The describer specifies the Class_of_physical_object whose members hold information that describe members of the described Class.

The describer role corresponds to role_2 of the Common_association cardinality data.

7.65.2 common_presentation_of_class_of_encoded_information_by_physical_object

A Common_presentation_of_class_of_encoded_information_by_physical_object is a Common_association that is a specialization of presentation_of_encoded_information_by_physical_object that constrains members of the presenter Class_of_physical_object to present members of the presented Class_of_encoded_information.

EXAMPLE The class of relationship between the Class_of_physical_object "computer floppy disk" and the Class_of_encoded_information "binary encoded data" is a Common_presentation_of_class_of_encoded_information_by_physical_object.

EXPRESS specification:

```
*)
ENTITY common_presentation_of_class_of_encoded_information_by_physical_object
   SUBTYPE OF (common_association);
   presented : class_of_encoded_information;
   presenter : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

presented: The presented specifies the Class_of_encoded_information whose members may be presented by members of the presenter Class_of_physical_object.

The presented role corresponds to role_1 of the Common_association cardinality data.

presenter: The presenter specifies the Class_of_physical_object whose members present members of the presented Class_of_encoded_information.

The presenter role corresponds to role_2 of the Common_association cardinality data.

7.65.3 common_reference_between_information_presenters

A Common_reference_between_information_presenters is a Common_reference_to_object_within_physical_object where the referenced Class is a Class_of_physical_object.

EXPRESS specification:

```
*)
ENTITY common_reference_between_information_presenters
   SUBTYPE OF (common_reference_to_object_within_physical_object);
   SELF\common_reference_to_object_within_physical_object.referenced :
      class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Class_of_physical_object whose members are referenced by information carried by members of the referencer Class_of_physical_object.

The referenced role corresponds to role_1 of the common_association cardinality data.

7.65.4 common_reference_to_object_within_physical_object

A Common_reference_to_object_within_physical_object is a Common_association that is a specialization of Reference_to_object_within_physical_object that constrains members of the referencer class to carry information that references members of the referenced class.

EXAMPLE The class of relationship between the Class_of_physical_object "vessel safety certificate" and the Class "vessel" indicating that vessel safety certificates reference a vessel is a Common_reference_to_object_within_physical_object.

EXPRESS specification:

```
*)
ENTITY common_reference_to_object_within_physical_object
   SUBTYPE OF (common_association);
   referenced : class;
   referencer : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

referenced: The referenced specifies the Class whose members are referenced by information carried by members of the referencer Class_of_physical_object.

The referenced role corresponds to role_1 of the Common_association cardinality data.

referencer: The referencer specifies the Class_of_physical_object whose members hold information that references mebers of the referenced Class.

The referencer role corresponds to role_2 of the Common_association cardinality data.

7.65.5 common_symbolization_of_object_by_physical_object

A Common_symbolization_of_object_by_physical_object is a Common_association that is a specialization of Symbolization_of_object_by_physical_object that constrains members of the symbolised Class be symbolised by members of the symbolized Class_of_physical_object.

EXAMPLE ???

EXPRESS specification:

```
*)
ENTITY common_symbolization_of_object_by_physical_object
   SUBTYPE OF (common_association);
   symbolized : class;
   symbolizer : class_of_physical_object;
END_ENTITY;
(*
```

Attribute definitions:

symbolized: The symbolized specifies the Class whose members may be symbolized by members of the symbolizer class.

The symbolized role corresponds to role_1 of the Common_association cardinality data.

symbolizer: The symbolizer specifies the Class_of_physical_object whose members can symbolize members of the symbolized Class.

The symbolizer role corresponds to role_2 of the Common_association cardinality data.

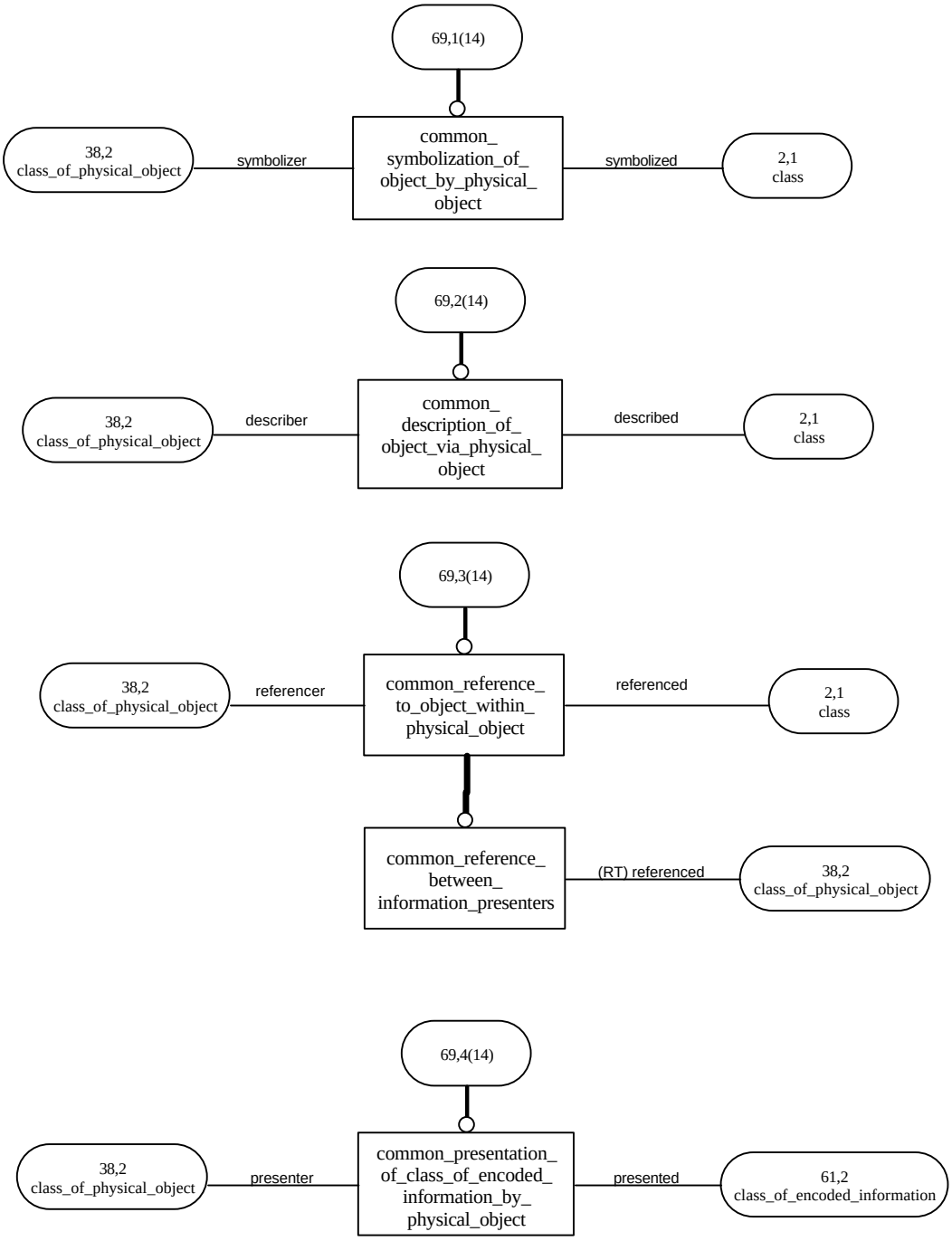


Figure 69 – EXPRESS-G diagram of the oil_and_gas_production_facilities_schema – Class of information presenter

7.66 Annotation element

This section is deliberately omitted.

```
*)
END_SCHEMA;
(*
```

Annex A
(normative)

Information object registration

A.1 Document Registration

To provide for unambiguous identification of an information object in an open system, the object identifier

```
{iso standard 15926 part{2} version {1}}
```

is assigned to this part of ISO 15926. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 15926-1.

NOTE - This is the object identifier that will apply to the published (IS) version of this part.

A.2 Schema identification

To provide for unambiguous identification of the oil_and_gas_production_facilities_schema in an open system, the object identifier

```
{ iso standard 15926 part(2) version(1) object(1) oil-and-gas-production-
                        facilities-schema (1) }
```

is assigned to the oil_and_gas_production_facilities_schema (see clause 6). The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 15926-1.

NOTE - This is the object identifier that will apply to the published (IS) version of this schema.

Annex B
(informative)

Data Model Design

This data model is designed in accordance with the EPISTLE[2] principles [3]. These principles control the use of entities, attributes and relationships that form the model. The objective of the principles is to produce flexible, generic data models that minimise the life cycle costs of systems in the face of changing business practices and requirements.

There are six EPISTLE Framework principles:

a) Attribute domains should in most cases be defined as entity types. This enables information to be referred to and is a major contributor to stability and flexibility. Data models conforming to this principle have relatively few simple data type attributes.

b) Entities should have an internal identifier within a database or exchange file. It should be artificial and managed to be unique. The internal identifier is the system surrogate for the real world object the instance represents. The internal identifier is separate from any external identifiers. External identifiers are things such as names, serial numbers used externally to any data base (i.e. in the real world). A thing may have many external identifiers. These data are part of the data model requirement and handled accordingly.

c) Activities and associations should be represented by entities (not by relationships or attributes). This enables information to be maintained about the involvements of two or more things, including the existence and circumstances of each episode (history).

d) Relationships (in the entity/relationship sense) should only be used to express the involvement of entities with activities or associations.

e) Entities should represent, and be named after, the underlying nature of an object, not the role it plays in a particular context, so avoiding the duplication of the same object when found in different contexts. Such entities are called *generic entities*.

f) Entities should be part of a supertype/subtype hierarchy of generic entities in order to define a universal context for the model, and avoiding duplication of concepts. The EPISTLE framework provides such a type hierarchy.

By applying these principles, it is important to recognise that the outcome is a conceptual data model, representing the underlying (and hopefully unchanging) nature of the things that we are concerned with, supporting any valid external information view. Business rules are excluded, as these are liable to change and would require any model that includes them to be changed, which in turn requires any system implementations to change.

[2] EPISTLE - European Process Industries STEP Technical Liaison Executive.

Bibliography

[1] WEST, Mathew; FOWLER, Julian. *Developing High Quality Data Models*. Version 2.0, Issue 2.1. EPISTLE, 1996. Available from http://www.stepcom.ncl.ac.uk.

[2] American National Standards Institute Standards Planning and Requirements Committee, Computers and Information Processing (ANSI/X3), 1975.

[3] ANGUS, Chris; DZIULKA, Peter. *EPISTLE Framework.* Version 2.0, Issue 1.21. EPISTLE, April 1998. Available from http://www.stepcom.ncl.ac.uk.

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